SDs IN 2019 WHAT'S HERE AND WHAT'S COMING

apc

Feb 2019
Issue 464

YOUR EXPERT

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AY MEDIA ON A PC
E WAY YOU WANT

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URROUND SOUND
ET UP YOUR MEDIA NAS

EST MEDIA IAS REVIEWED

LONE IT

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R BACKUP OR TO MOVE TO A NEW PC

INCLUDES GUIDES FOR RASPBERRY PI 3

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BUYING A NEW PC

DIY vs. SHOP BUILT vs. BIG BRAND

WHICH WINS FOR VALUE, PERFORMANCE, UPGRADEBILITY & RELIABILITY?

LATEST REVIEWS

ASUS VIVOBOOK

PLUS NEW FRITZBOX
> D-LINK VIPER 2600
> MSI TRIDENT X PC > RAZER NARI
> HYPERX FURY RGB > VOLTA XL

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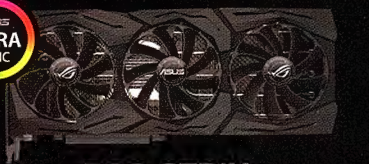

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Hit play

The ultimate jukebox.

There once was a time when media was seen as the PC's 'killer app'. It started with enthusiasts building dedicated boxes that were hooked up to the TV or audio system either directly, or on a network. Upon its hard drive were season's worth of TV episodes, usually. This was a time when torrenting was at its peak, and seeing as you had to store those files somewhere, you may as well have them somewhere that's easy to just hit play and off you go.

Microsoft tried to cut itself a slice of that cake with its Windows Media Center OS (first seen in Win XP, 2002), which was a good product and it's a shame it was abandoned a few years later. It was at its best when running on a dedicated media PC in Media Center mode, but Microsoft banked a little too heavily on it being a mode you'd switch over to on the work or family PC when it was movie or TV time. At the time the mainstream user, it seemed, didn't want a slick yet slow interface when a folder full of files that played with mediaplayer.exe would suffice.

For a while PVRs seemed to take up the mantle, but their reliance on EPGs dulled the appeal thanks to the seemingly endless legal battles underway to remove that functionality.

Fast forward to today and it's a streaming world. Functionally, the likes of Netflix, Stan and even Foxtel's on demand library do everything a media PC can. Or do they? As vast as these vaults of content are they are still of limited use. Older titles are few and far between, some content is only available for a limited period and for the most part what content there is, is driven by mainstream popularity, which means quite a few of your personal favourite things are going to be hard to come by.

So, as it does, the PC is re-emerging as a vital part of how we manage our music, movies, and TV. Which leads us to this month's Superguide. We're all about the media this month, so if you're looking for a few cool tips to streamline things, or perhaps want to embark on a build for a dedicated media PC, we've got you covered. ■

BEN MANSILL
EDITOR
ben.mansill@futurenet.com

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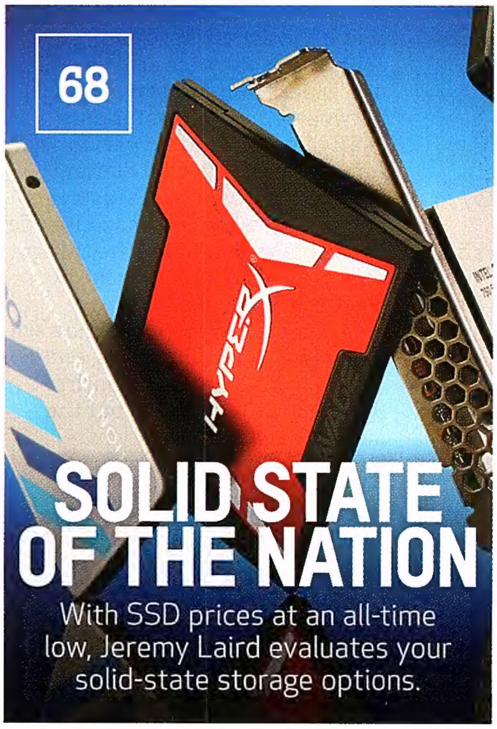
LEARN HOW TO HACK, CODE AND MAKE WITH THE INCREDIBLE RASPBERRY PI.



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Ashampoo Burning Studio 2019 is a powerful disc burning software for CD, DVD and Blu-ray discs. Core features include burning of files, audio and video to standard blank discs but also specialized media such as BDXL or M-Disc. The built-in disc ripping supports auto-detection of track names and audio files can easily be turned into custom audio discs complete with individually designed covers and inlays as well as playlists for easy playback. The program can also finalize discs to make them playable on older retail players. Ashampoo Burning Studio 2019 features disc spanning that automatically spreads data across multiple volumes and avoids size constraints.

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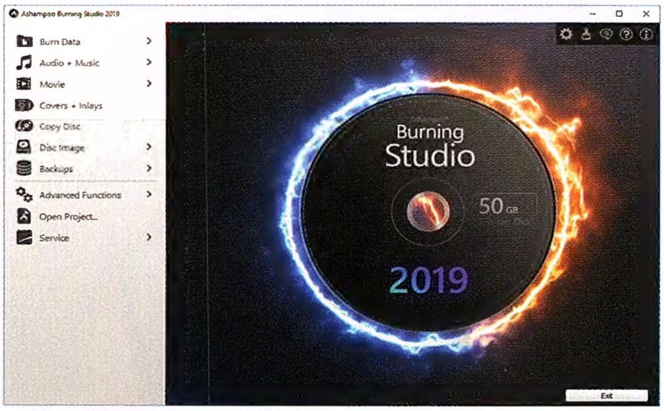

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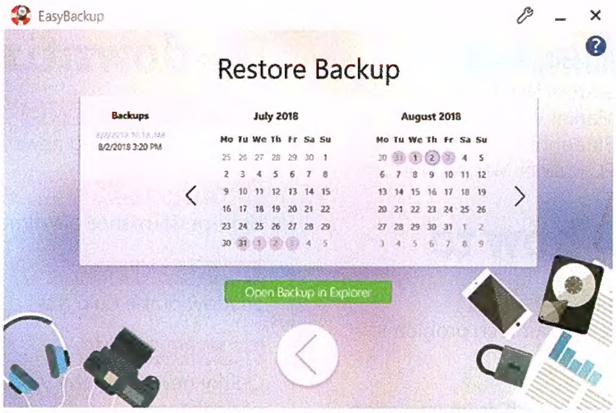

Backups
8/2/2018 3:20 PM

July 2018

Mo	Tu	We	Th	Fr	Sa	Su
25	26	27	28	29	30	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

August 2018

Mo	Tu	We	Th	Fr	Sa	Su
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

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apc RECOMMENDS
MSI Trident X
Small size, big performance
"The specifications are one thing, but MSI has really produced a gorgeous chassis to contain these powerful components."
Verdict
Asus VivoBook S15 S530F
Fritz!Box 7590
HyperX Fury RGB 480GB SSD

Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

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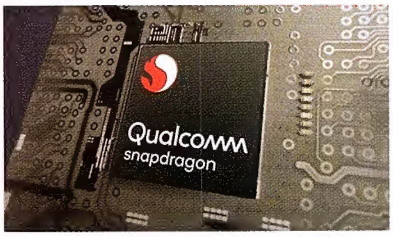

Qualcomm's Snapdragon 855 has been officially announced

PROMISES TWICE THE PERFORMANCE OF THE IPHONE XS CHIP.

Although we're not yet sure which phones will be landing with Qualcomm's next Snapdragon processor (except the next OnePlus flagship), the 855 has been officially announced. Qualcomm has stated that it will be able to handle 5G connectivity and, thanks to its 7nm architecture and a Kryo 485 CPU at its core, perform 45% better than the 845 overall. **HD**

Windows 10 finally overtakes Windows 7 to become undisputed desktop OS champ

IT'S NOW TOP DOG ACCORDING TO BOTH NETMARKETSHARE AND STATCOUNTER.

Netmarketshare's December 2018 numbers show that Windows 10 is installed on 39.22% of PCs, with Windows 7 only on 36.9%, while another analytics company, Statcounter, claimed the overtake took place almost a year earlier. While the discrepancy is due to the different ways the data is collected and analysed, the message is now loud and clear, with Windows 7 losing Microsoft's extended support from January 14, 2020. **HD**

AMD processors are set to land in Chromebooks

CHROME, MEET TEAM RED.

For the longest time, Chromebooks have included either Intel or ARM-based processors across the board and have notably excluded AMD. But, at CES 2019, there have been plenty of Chromebooks announced with AMD processors for the first time. The HP Chromebook 14 and Acer Chromebook 315 are chief among the announcements, although we're yet to learn of any Australian pricing and details. **HD**

Announcing the Australian PC Awards!

It's time for you to reward excellence.

We know you are passionate about the gear you own, or read about. You may have had fantastic experiences with a company or product that stands out from the rest. You may have especially warm feelings towards a particular company that's never let you down. It is only right, then, that the hard work and clever design that goes into making the gear you love is properly rewarded – and that's why we would like to invite you to vote for what truly impressed you in the world of PC tech through 2018.

The *Australian PC Awards* was launched in 2017 by *PC & Tech Authority* and *PC PowerPlay*, both of which now call Future Publishing home – along with the tech brands you know so well, including *APC*, *Tech Radar* and *TechLife*. As a reader of one or all of these mags and sites, you are highly regarded by the tech industry as someone with an informed opinion that they respect. Thus, when a company wins an *Australian PC Award*, as voted for by you, it hits home as a true recognition of talent and hard work. It's a big deal in the tech industry, and you make it happen.

Voting covers many categories, covering all the important components and peripherals. The team here at Future Publishing have selected the finalists for what we think are the best products that came out during 2018, and it's up to you to select the best of the best. It's simple to cast your vote, just head to **www.australianpcawards.com.au** and voting is open between February 7th and February 28th. We will be hosting a gala awards night on March 21, and the next day we'll announce the winners publicly.

So, jump in and cast your vote – you could even win a nice prize for taking the time to do so. **Ben Mansill**

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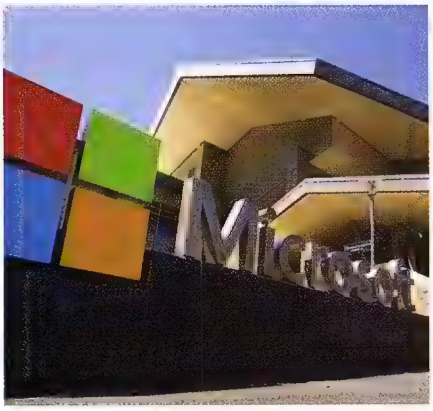


Microsoft wants to let you know what data of yours it has with Project Bali

AS DATA PRIVACY BECOMES A GROWING TOPIC OF CONCERN.

Although details are scarce, Microsoft Research is working on a new project, codenamed "Bali", designed to give users greater control over the data collected about them online, even giving them the ability to monetise it. It's based on the concept of inverse privacy, where an item of personal information is inversely private if a third party has access to it but the creator or user of it does not. **HD**

USB-C to get improved security in fight against malware-laden USB sticks

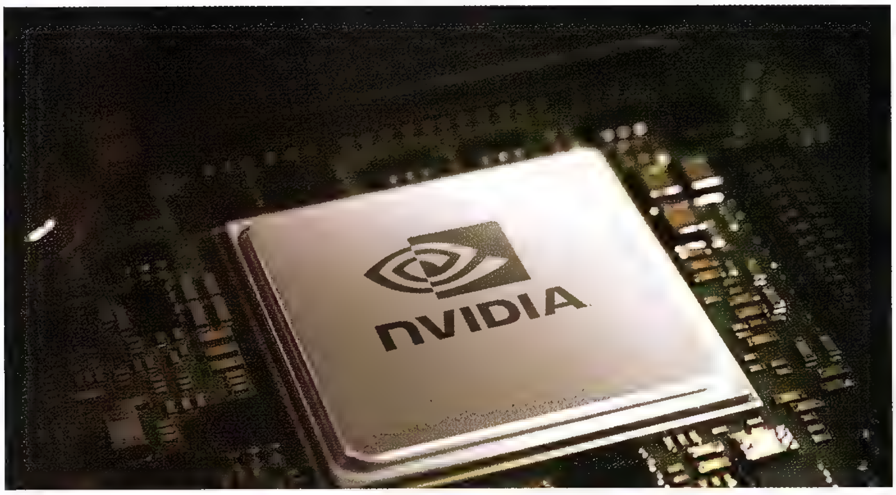
MALICIOUS CHARGERS ALSO TARGETED.

The USB Implementers Forum (USB-IF), an organisation dedicated to advancing USB technology, has laid out plans for a cryptographic-based 128-bit authentication system to help defend against non-compliant USB sticks and chargers. This USB Type-C Authentication Program implements a standard protocol to be able to identify and authenticate certified USB-C devices before any power or data can be maliciously piped into the host system. **HD**

A NSW early warning service was hacked

ALTHOUGH NOTHING NEFARIOUS WAS DONE.

After a hacker gained access to Early Warning Network – a private company that services NSW councils with fire, weather and other alerts – they issued a message via email, text and landline warning of the unsecured system. Before the hacker was stopped, a small proportion of the database received a message warning that their "personal data is not safe", although nothing malicious has yet been discovered. **HD**



Nvidia GPUs built with Samsung's 7nm process could come in 2020

Samsung might drive PC graphics in 2020.

Nvidia is reportedly courting phone maker-meets-processor manufacturer Samsung for a 2020 line of RTX desktop graphics cards built using Samsung's 7-nanometer (nm) transistor process. This comes from Japan's My Navi News, claiming access to Samsung sources and information. The processors will be developed using Samsung's extreme ultraviolet lithography (EUV) process, which uses a plasma laser to drive silicon material into 7nm transistor structures. Nvidia's latest graphics architecture, Turing, is built on Taiwan Semiconductor Manufacturing Company's (TSMC) 12nm process, and the firm was reportedly slated to build its 7nm RTX graphics processors on TSMC's matching silicon. The switch could be due to Samsung being further along in its EUV plans than TSMC and other competitors, such as Intel. Of course, ARM has several processors based on its 7nm chipset designs on the market already, particularly from Apple (A12X Bionic) and Qualcomm (Snapdragon 855 and 8cx). With 7nm processors driving its GPUs, Nvidia can either produce new cards with lower power consumption or even higher performance. **HD**

FTTB and FTTC customers are the most likely to recommend the NBN

SATELLITE CUSTOMERS, ON THE OTHER HAND...

NBN Co has recently released figures on how likely its users are to recommend the same technology that they use. The figures have been recorded each July since (and including) 2015, and are presented as a percentage of people that would advocate the particular service that's provided to them. The scores themselves aren't a direct measure of performance, but they are at least indicative of customer satisfaction. While Fibre to the Basement (FTTB) had a shaky start, declining from 53% to 40% in 2017, in July 2018 an impressive 71% of users would recommend the service. A similarly high percentage (68%) of Fibre to the Curb (FTTC) users reckon the service isn't all that bad, although this is first year they've had a say in the matter. As for the controversial satellite service, the percentage willing to recommend it has declined by about 10% each year since 2016, currently sitting at 43%. Overall satisfaction with Fibre to the Premises (FTTP) and Fibre to the Node (FTTN) has been largely stable over the last three-to-four years, hovering around 60% and 50% respectively. **HD**

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MOST FUN
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HAVE WITH
YOUR HANDS
WITHOUT
GOING
BLIND

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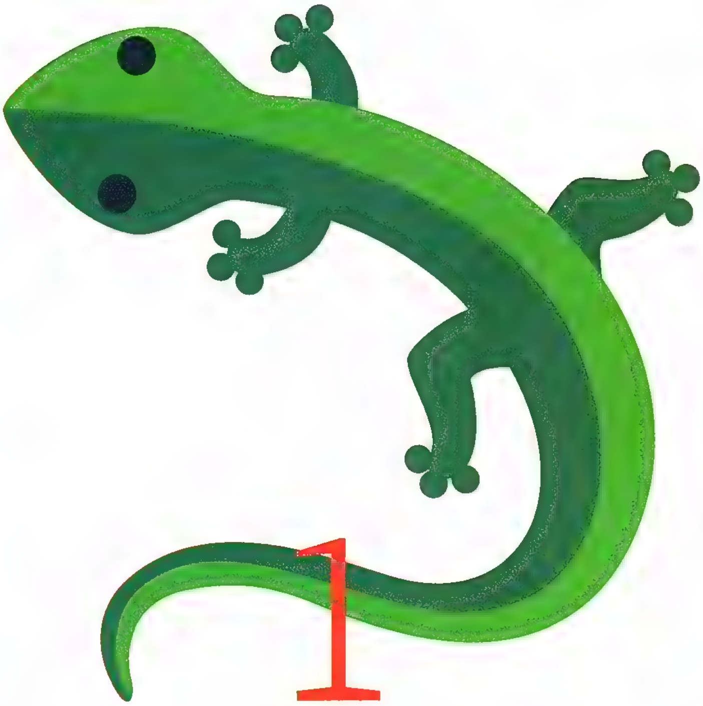
» WE LOOK AT THE NUMBERS DRIVING THE BIG TECH NEWS.



1 “BAZILLION”

NUMBER OF PHONE CALLS ALLEGEDLY MADE BY A TINY GECKO USING A TOUCHSCREEN DESK PHONE IN AN ANIMAL HOSPITAL IN HAWAII.

The calls were inadvertently made by the gecko, thanks to the sticky pads on its feet, after he’d snuck into the Ke Kai Ola Marine Mammal Centre on the US island.

220 GB

AMOUNT OF DATA APPARENTLY LOST BY ONE WINDOWS 10 USER.

after upgrading to the October 2018 Update (version 1809), with numerous other reports of similar issues from users who’d signed up to Windows Insider. Microsoft temporarily halted the rollout of the feature update in October until it was able to resolve the issue.

2 SECONDS

0-60MPH TIME OF THE PB18 E-TRON ELECTRIC CAR CONCEPT UNVEILED BY AUDI AT THE PARIS MOTOR SHOW.

The car also has a moveable console that enables it to turn from a two-seat roadster into a single-seat racer at the touch of a button, with the driver’s monocoque seating position shifting to the middle of the vehicle in seconds.

US$234 MILLION

AMOUNT OF MONEY APPLE WON’T NOW BE PAYING IN FINES.

... after a federal appeals court in the US ruled that Apple hadn’t infringed patents held by University of Wisconsin-Madison after all. The University’s licensing arm originally filed a lawsuit in 2014 saying processors used in the iPhone and iPad used several technologies that the University had created. The case has now been dismissed.

3.20-3.28PM

TIME DATA TAKEN FROM A FITBIT WATCH, WHICH WAS USED AS EVIDENCE IN A MURDER TRIAL IN THE US.

Detectives showed that victim Kim Navarra’s heart rate peaked at 3.20pm before stopping completely at 3.28pm. This information, along with CCTV footage and the discovery of bloodstained clothing, was used to convict Anthony Aiello, the girl’s stepfather, of the crime. ■

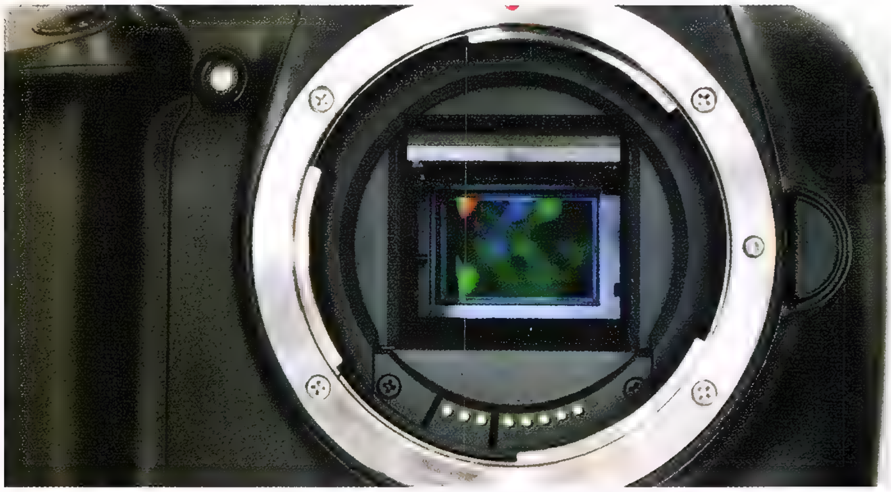
techbrief

» SHARMISHTA SARKAR AND BEN MANSILL TAKE A DEEPER LOOK AT TRENDING NEWS.

The evolution of existing technology

With technology constantly evolving, what does 2019 have in store for us?

Technology has been a part of our lives in some form or another for most of human history. It has evolved over the years, and wehave had the privilege of seeing the current accelerated evolution take place right in front of our eyes. Mobile phones went from being chunky and heavy devices to the sleek, practically bezel-less smartphones we have today. Personal computers went from being a luxury item to a necessity that can even be used as a tablet. 3D printing is on the way to making us practically anything we can imagine. Cameras went from analog film versions to the digital masterpieces we use today. And let's not forget the artificial intelligence – not only making everything smarter, including our homes, but is bringing autonomy to cars, drones and robots. While some aspects of technology are still in their infancy, here's what to expect in 2019.



Camera sensors are getting densely packed with pixels

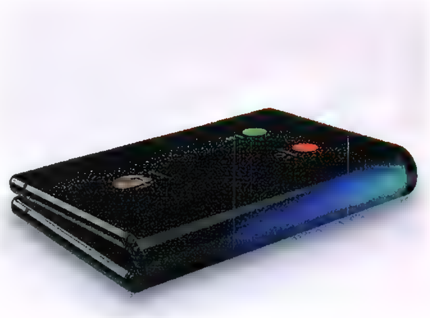
High resolution snappers with multiple lenses on smartphones.

Every photography manufacturer is working on high-resolution sensors – Canon has demonstrated a 120MP APS-H CMOS sensor alongside a full-frame one capable of shooting at 100fps, while Panasonic has announced the development of an 8K camera that uses an organic sensor. And while DSLR cameras are making way for full-frame mirrorless counterparts, smartphone snappers are also getting more complex. Samsung has developed 48MP and 32MP sensors for multi-camera smartphones that could arrive in 2019, like the Huawei Mate 30 Pro and Samsung's own Galaxy S10.

CPU nm wars

A little bit smaller now...

The smaller the circuits on a CPU are, the more can fit on a die, which increases performance, reduces manufacturing costs, and potentially reduces power consumption. AMD is set to move to 7nm with its Zen 2 CPU core and Navi GPU in early 2019, while Intel is stuck on 14nm; and it's likely AMD will hold this advantage for almost all of 2019. Let's see if AMD can capitalise on this competitive gift.



Smartphones are getting more futuristic

Foldable handsets and in-screen fingerprint scanners.

Samsung showed off a prototype of its upcoming foldable phone in 2018, but there is competition brewing. LG is said to be working on its own version, while Chinese manufacturers Huawei and Oppo expected to launch theirs in 2019 as well. While Qualcomm says its chips will be ready to support folding phones, Google has also announced Android support. Fingerprint scanners are also set to move to the screen, with Xiaomi, Samsung and Vivo among those adding in-screen fingerprint tech to their flagships. 2019 could also see the launch of the first 5G handsets as well.

SSDs: Samsung Z-NAND vs Intel Xpoint

SSDs battle at the premium end.

Intel and Micron's extremely quick Xpoint memory – as seen on Intel Optane products – certainly delivers high performance, but is very expensive. Samsung, in the meantime, has been developing a new type of NAND for SSDs that could double data density and offer up to 10x lower read latency. If Samsung can deliver competitive Z-NAND products at prices that undercut Optane products the storage market could see even greater Samsung domination.

Apple a major player in CPUs

At the core of matters.

A 2017 report from *Bloomberg* stated that Apple intends to replace Intel's processors inside its Macbooks by 2020 with its own CPU, and it's well on track. After heavy investments in engineering talent, Apple is designing CPUs that deliver performance on par with the best a PC can offer. The ARM-based A12 X in the current iPhone XS scores 4793 points in Geekbench's single-core test, compared to an AMD Threadripper's 4,801, so it's a safe bet the CPU scene will see a shakeup through 2019. ■

gadgets

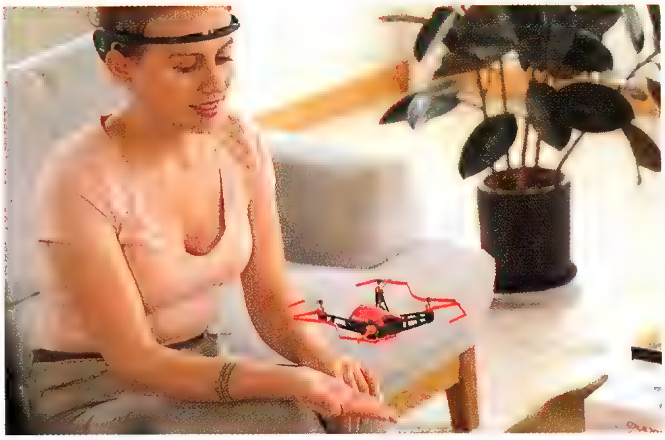
» GOOD GEAR

EEG SMART UDRONE

Fly, my pretties, fly!

$TBA | WWW.EEGSMART.COM

Perhaps unsurprisingly, you can now buy a mind-controlled drone. The EEG Smart Udrone itself is a regular small indoor flier, and it can use its camera to read your facial expressions, hand gestures, head movements and more ("blink twice to take a photo, land by biting your teeth"). It takes more than that to impress us, though. Colour us impressed, then, by the headband that measures your brain's electrical activity as you, allegedly, imagine the drone lifting off, and it does. Indeed. We have one on the way for some enthusiastic testing. Wars of the future will be fought with these things, most likely.



CYGNETT WIRELESS CHARGERS

Plonking down and powering up.

$89 (RACE), $129 (TWOFOLD), $59 (PRIME) | WWW.CYGNETT.COM

A trio of wireless phone chargers from Cygnett landed on our desks a few days ago, so we've been charging our phones the fancy way lately. Fancy, but slow. Although they boast fast charging it still takes roughly twice as long compared to the normal method. Still, it's a big win for minor convenience. There's the Prime for a single device, and it has a little flipstand so you can view your screen while it's being juiced. The TwoFold can handle two devices simultaneously, and the Race is for cars, with a suction cup holder. Cygnett appear sto be on top of this game and they're definitely well made and thoughtfully designed.

GLADIUS UNDERWATER DRONE

It swam all under the dam.

$2,599 | WWW.CHASING-INNOVATION.COM

Most Aussies live somewhat near the water, so if you hit the beach or a boat regularly then the appeal of this large shoebox-sized marvel is deep. Controlled via Wi-Fi at a range of up to 100m via a game console-style controller, it will run deep for up to three hours recording 4K video at 30FPS or taking 12MP photos. The lens is optimised for underwater optics so any curious dolphin faces or shark teeth are proportionally correct. There's a Standard version that's a bit cheaper at $1,999 which does Full HD @ 30FPS instead of 4K, has 16GB onboard instead of 64GB and is limited to 50M depth. It probably has practical uses, but all we can see is the ultimate beach and boat toy.

RAZER TURRET

Xbox levels up.

US$249 | WWW.RAZER.COM

Your eyes are telling you this is just another keyboard and mouse, but, in fact, this is a profoundly meaningful event for Xbox gamers. You see, Microsoft recently opened up support for mouse and keyboard on the Xbox One, and the Razer Turret – along with similar products from Corsair and others – allow PC master race superior control on a console. PS4 has supported this for years. Now fumbling and hoping for the best in shooters enters a new epoch where Xbox players can actually enjoy the superior accuracy we've long enjoyed on PC. It has a slide-out mouse pad, is wireless with a claimed 43 hour battery life and anyone with this will probably win more in *Fortnite*.

SONY XB501G EXTRA BASS

So everyone knows it's party time.

$399 | WWW.SONY.COM.AU

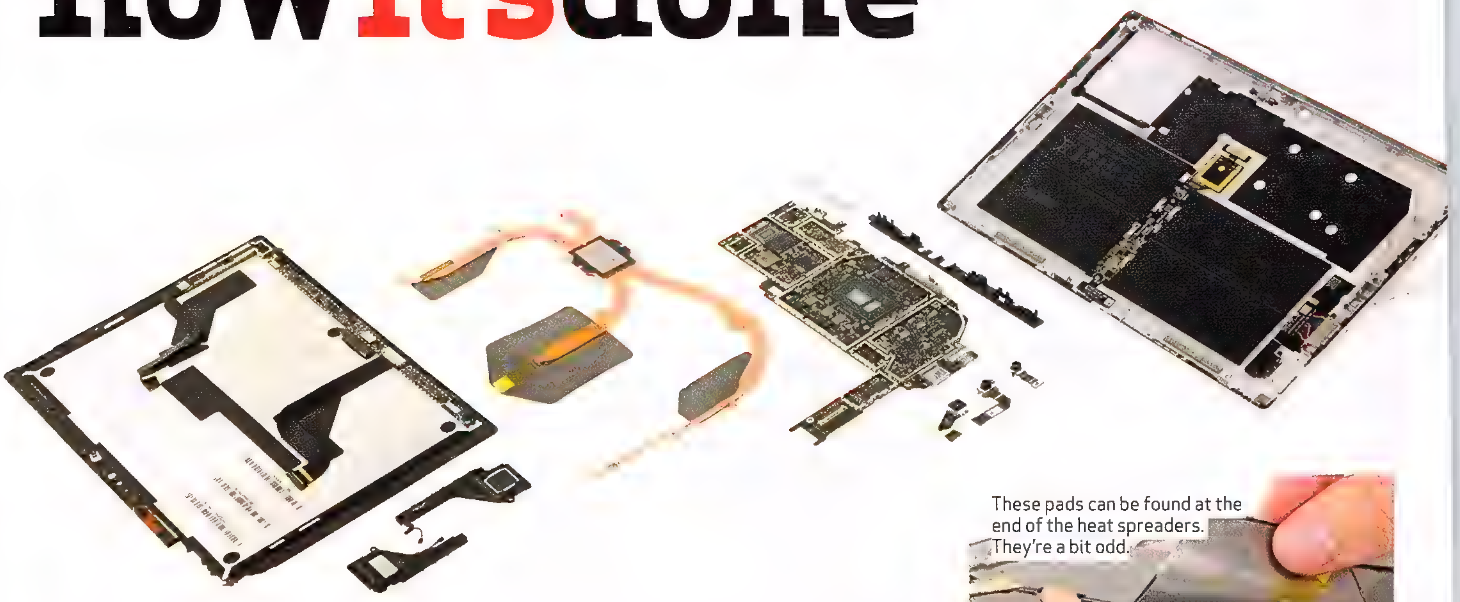
Our weapon of choice when it comes to high quality music with Google Assistant built in is Google's own absolutely superb Google Home Max. Those that aren't excited by the Google's subdued look and neutral sound stage may want to consider this new Sony, where there's absolutely no mistaking party time when it's going down. An RGB strip around the perimeter blings to the beat, and the beat itself is extra phat, by design. A proper subwoofer is paired with angled satellites to create a wide, non-directional sound, and we can't let it pass that the arrangement of the speakers creates a lovely *The Scream* face, which pleases us as we get on down. It's as tough as heck with dust, splash and rain proofing, and has a built in carry handle, so it's got pool party written all over it.

ROAM ROBOTIC SKI XO

Power through the powder.

$TBA | WWW.ROAMROBOTICS.COM

This isn't a fully powered exoskeleton (or 'XO' as the cool kids apparently say), nevertheless it's darned impressive. The joints aren't powered, rather they have an adjustable torque effect that alleviates the load on your knee joints as you ski. It means you can relax a little more if you're out there for hours as it takes the loads off your muscles and joints, it means that ski-noobs feel more confident as they learn the proper skiing posture, and perhaps best of all it allows older skiers and those without the full use of their leg strength to enjoy the slopes again. Currently only available for rental in the U.S. it's only a matter of time before this and others like it become mainstream. ■



These pads can be found at the end of the heat spreaders. They're a bit odd.

Microsoft Surface Pro 6

We take a look inside one of our favourite 2-in-1 machines.

Microsoft has decided once again to grace its Surfaces with numbers. This year's Surface Pro 6 comes with a sleek new black paint job and the first ever quad-core processor in a Surface device. What else will we find inside? Let's find out!

MAJOR TECH SPECS

- 12.3-inch 2736x1824 (267 ppi) PixelSense display
- 8th-Gen quad-core Core i5 with Intel UHD Graphics 620
- 8GB RAM (16GB optional)
- 128GB solid-state storage (256GB, 512GB, or 1TB options)
- 8MP rear-facing camera with 1080p video, and 5MP/1080p front-facing Windows Hello camera
- USB 3.0, microSDXC, Mini DisplayPort, SurfaceConnect, 3.5mm audio port, 802.11a/b/g/n/ac, and Bluetooth 4.1

You need to be very patient when opening Microsoft's latest.

KEY FINDINGS

- On the outside, not much has changed. Still the same case, hinge, and relatively healthy number of ports. Noticeably absent, however, is the USB-C port that found its way on to the Surface Go. The Surface Pro series has a few different configurations, all with upgraded adhesive as standard.
- Luckily, we've got a recipe for screen separation success:
  Step 1: Apply iOpener liberally.
  Step 2: Grab an opening pick and suction handle, and fight for dear life through Microsoft's gauntlet of adhesive.
  Step 3 (optional): Get impatient, break screen.
  Fortunately, we don't run into any surprises as we free the display – everything's much the same as before, save for an extra display cable compared to the Surface Go.
- It seems Microsoft has been meddling with its passive cooler – it looks like last year's, but with an extra pipe down the left side, plus some funky heat-spreading pads.
- Looking south, the similarities continue, with a quad-cell battery taking up most of the case. On the plus side, all the screws so far are standard Torx. Let's twirl them out! The Surface Pro 4 had a copper heat spreader, but these look like graphite. Now we're free to remove the heatsink.
- We've come to that inevitable junction in any Surface teardown: Take out the heavily glued battery, or leave it be? Considering there are no stretch release battery tabs, we opt to let the beast slumber for now. It weighs in at 45Wh (7.57V x 5,940mAh), exactly the same at last year.
- Really scraping the bottom of the barrel, hoping for something new, we pull out the speakers and cameras. The cameras are still hidden under the bracket holding the antennas (which are incredibly easy to mangle upon opening), while the speakers are still corner-mounted triangles for that surround-sound feel.
- Repairability score: 1 out of 10 (10 is easiest to repair). To the extent that screws are used, they are all standard Torx fasteners. This tablet still has a headphone jack, which is modular and replaceable, if you can get to it. All repairs require first removing the display assembly – which is stubbornly glued in place, expensive, and prone to shattering. The battery is firmly glued in place, with its connector pinned under the motherboard – requiring near-total disassembly for service. Once upon a time, Surface Pro storage was removable – but not in this version. Complex construction makes all disassembly and reassembly tedious in comparison to other tablets. ■

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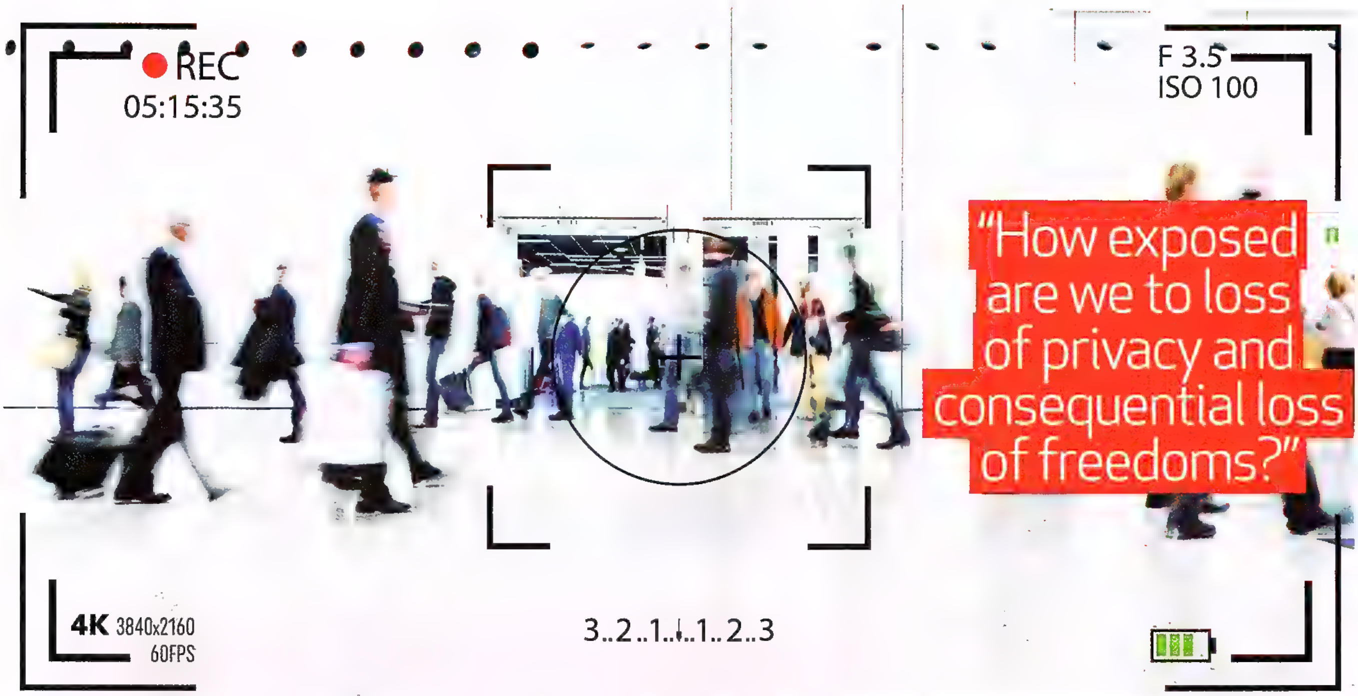

"How exposed are we to loss of privacy and consequential loss of freedoms?"

DOES PRIVACY EXIST ANYMORE?

There are essential questions on privacy and security that are not covered in the Jan 2019 issue that deserve much closer attention.

With the widespread use of facial recognition some nations are now using this data to limit people's access to goods and services. This is an emerging means of State control over individuals that is not protected by an independent justice system.

For example a person may not be able to purchase an airline ticket if the State deems them problematic. Such control could be used to crackdown on religious freedoms in certain countries.

Now with home and personal devices listening, watching and reporting back to base, how exposed are we to loss of privacy and consequential loss of freedoms?

For example how protected is our facial recognition data at airport passport control? How protected is our finger print ID on our phones? What is the risk of smart speakers and smart phone apps secretly reporting our conversations to unknown powers?

We now live in a world where nations such as Turkey, Iran, Russia, China, North Korea and the Philippines have invoked dictatorships.

Therefore how at risk are we that the technological convenience of facial, voice and fingerprint recognition will be used to erode and potentially deny us freedom of speech, freedom of religion and freedom of association?

Peter

THE APC COOKBOOK

I have been an *APC* and *PC & Tech Authority* reader for eons, and I fully understand the commercial imperatives for merging the two mags. However, I note in the latest edition Arduino and Pi tutes have been dropped.

I also appreciate there is a fairly large market for games and hence a little more emphasis on that market in the first merged edition. Of course there are also many readers who don't game, and have only token but general interest in video hardware.

My concern is to highlight balance across the broad spectrum of topics and I will be devastated if we don't see Pi, Arduino type articles. (we love Darren). Best of luck with the new mag/team but hope you can get Pi, Arduino back into the mix.

Brian

Ben Mansill replies: *Thanks for writing in, Brian. As you wisely appreciate, there's a wide world of computing to cover and how we balance what can be done in a month with what we understand our readers want will never be the ideal mix for every reader. There's no more, or less, gaming in APC now, after the merger, and that's not expected to change. We love Darren too, and he'll always be a welcome APC contributor. As for Pi, we've gone all out this issue with a major Pi feature so – to all readers – let me know if that hit the mark.* ■

APCMAG@FUTURENET.COM

Come on, have your say!

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Apple admits that battery replacements have hurt 2018 iPhone models

The company would prefer you replace your phone, rather than fix it, writes Shaun Prescott.

Apple has sold over a billion iPhones since 2007. When sales figures this astronomical are mentioned, we're likely to speculate about how wealthy Apple and its executives have become, or else marvel at the huge cultural and societal shifts the smartphone has imposed on our lives. But arguably more eye-opening is the question of where these smartphones go when they die.

Apple has its own initiatives for recycling so-called "obsolete" technology, including Apple GiveBack – which exchanges old Apple technology with credit towards newer models. Elsewhere, it's released a series of robots designed to dismantle old technology in order to retrieve salvageable materials. It showcased Liam in 2016, followed by a smarter version of the robot, Daisy, in 2018. But these whimsical demonstrations of intent can't really account for the fact that once Apple has sold its phones, it really has no way of controlling what happens to them.

> "...the latest iPhones just aren't worth upgrading to for the very tiny iterative improvements they offer."

And that's the main driving force behind one of the biggest criticisms levelled at Apple over the years: that their products are not designed to last, indeed, they're designed not to last. Which is why some commentators seized on a recent letter written by Apple CEO to the company's investors (who are presumably unhappy that the latest iPhone hasn't exactly set the world ablaze). The letter touches on some of the reasons for this performance shortfall, and one of these is a tacit acknowledgement that the company is suffering due to customers' increasingly inclination to repair – rather than replace – their iPhone.

"While macroeconomic challenges in some markets were a key contributor to this trend, we believe there are other factors broadly impacting our iPhone performance, including consumers adapting to a world with fewer carrier subsidies, US dollar strength-related price increases, and some customers taking advantage of significantly reduced pricing for iPhone battery replacements."

It's not exactly "gotcha" material, but it does show that when a customer chooses to replace their battery rather than their entire phone, it hurts Apple's bottom line. Apple is famously averse to customers repairing their own iProducts: in 2017, the company moved to quash a "right to repair" bill in Nebraska, but its efforts didn't fall on empathetic ears.

And it's little wonder that people are starting to replace their batteries: in addition to all the points Cook mentions above, the latest iPhones just aren't worth upgrading to for the very tiny iterative improvements they offer. Meanwhile, with reports such as the recent one revealing Apple to be deliberately slowing its older phones down (in order to prolong their life, according to Apple), it's possible that consumers are raising their guard against tech companies' constant hectoring to upgrade, upgrade, upgrade. This is a hugely deleterious attitude to promote as the Earth plunges closer and closer to environmental disaster, and it's a bad look for a company that has always liked to tout its green credentials. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

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Head to head: DIY Rig vs. Boutique Builder vs. Big-Brand OEM

Do it yourself or pay the man?

For some, building your own rig is an essential part of the PC-owning experience. Only by building your own PC can you truly know it. For others, a system engineered by a big OEM can bring technology and features unavailable elsewhere. And what about boutique specialists? Don't they offer a certain attention to detail, and focus on the stuff that actually matters, and hardcore enthusiasts particularly appreciate? Game on.

APC has form when it comes to DIY builds.

Round 1

VALUE

Before the commoditisation of the PC and its components, the number one reason to build your own PC was to save money. Today? Not so much. Price up a pre-built rig, and compare it to the combined cost of buying its individual components, and the gap is often slim to none. What's more, that comparison usually doesn't take into account "extras," such as an OS and a warranty that covers the whole system.

Of course, home builders may be able to transfer an existing Windows license, or might have a drawer full of spare bits, or be a crackerjack fault-finder. It's also true that if you're patient, and pick up all your components on sale, you can still build something that significantly undercuts both boutique and big-brand pre-built PCs. You can, of course, also source used parts. In extremis, the best value opportunities remain in the DIY arena.

Speaking of pre-built options, the value proposition depends on your preferences and usage. For example, extreme overclocked systems are probably better bought from a boutique outfit, while the big boys tend to be better at shaving the last few cents off low-end and mid-range systems.

WINNER:
DIY.

Round 2

RELIABILITY AND SUPPORT

If value used to be the mainstay of the DIY option, reliability and support are the payoff. For starters, even if you buy all brand-new bits, you're only covered for individual items. If you know what's broken, that may be tolerable, but effective fault finding usually requires a box full of spare components for swapping in and isolating issues.

Likewise, what if one component fails and damages another? And what about cross compatibility of components? What if your CPU doesn't like the look of that fancy high-frequency RAM you found on special?

In reality, of course, component failure and incompatibilities are pretty rare these days. But you can't beat the ability to simply ring a number or raise a support ticket, and have your PC replaced or repaired in short order. With that in mind, the comparison between boutique and big OEMs when it comes to support is complicated. If you have a well-recognized fault, the big boys are usually very fast and efficient. If it's something a little harder to diagnose, the ability to speak with a sentient human being at a boutique outfit will be a blessed relief.

WINNER:
Boutique and big OEM—it depends on the fault.

Round 3

FEATURES AND TECHNOLOGY

This one really does depend on what you want. There are certain features and technologies only available to each of the three categories. Take any given PC builder, big or small, and you'll be able to find features they don't offer. Only a DIY rig gives you total control over component choice and features.

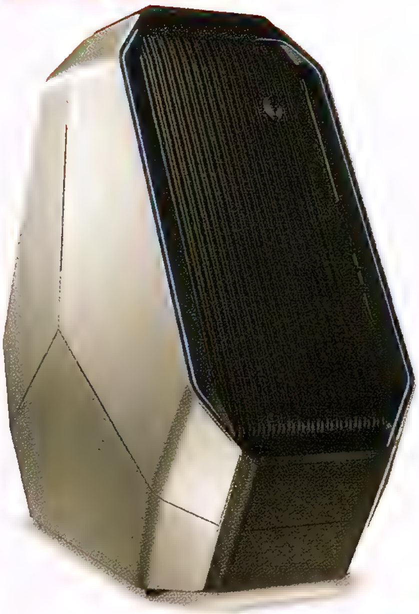
But that sense of control can be an illusion. If you happen to like the styling and features of, say, Alienware's latest "triad" design Area-51 chassis, good luck "choosing" that for a home build. Alienware doesn't sell it separately. The big boys certainly bring unmatched resources and engineering clout that occasionally translates into something special, which can't be had elsewhere. Similarly, the big brands sometimes have early or exclusive access to the latest and hottest components.

On the other hand, boutique brands are typically more aggressive when it comes to extreme performance or adopting items such as the latest cooling innovations. They're happier operating at the ragged edge with overclocked rigs, while big OEMs are more inclined to cover their behinds in triplicate, and go with proven and more conservative technology and settings.

WINNER:
Three-way tie.

> "If you have money to burn, and are happy being dictated to by the PC builder, a rig from a big OEM might well be your bag."

Boutique brands do some fabulous builds.



Big-brand engineering is not without charm.

Round 4

PERFORMANCE

How hot are your modding skills? Are you happy hand-tuning CAS latencies? Questions like these determine the performance of a home-built rig. You need to know what you're doing to not only successfully mix and match components and conceive the design of your rig, but also fine-tune the end result. You can match or even exceed the performance of any pre-built PC with your DIY rig, but it's down to you.

You'd think the big OEMs would have an advantage. After all, they surely have access to all the best technology and components, and the engineering clout and resources to combine them in ways that even the best boutiques can't. In practice, however, they are usually if not always quite conservative. They tend to build in relatively big volumes, and are risk averse when it comes to reliability and liability. They similarly aren't usually set up to hand-tune retail systems, so need to pursue more generic configurations.

Boutique outfits are better placed to have an experienced engineer hand-tune a retail rig, enabling them to push the envelope harder, while ensuring each rig is reliable.

WINNER:
Boutique builds, unless you really are an expert

Round 5

UPGRADEABILITY

If you've successfully built your own box, adding future upgrades isn't going to be a problem. What's more, you don't have to worry about voiding the warranty. In those senses, a DIY rig has obvious advantages over pre-built PCs. But there's more. When DIYing, you have full control over the configuration, enabling you to specify certain components, such as the PSU, with a view to supporting future upgrades. The same is arguably true of a good boutique build. The best have future-proofing in mind, and good boutique outfits offer sufficient options to ensure plenty of headroom. Some may even be flexible when it comes to warranty claims, provided any fault isn't associated with an upgrade.

As for the big OEMs, they're dead last in this category. They're more likely to have custom engineering, bespoke motherboards and PSUs, or other design elements that make upgrades difficult. They're also significantly less likely to be accommodating with regard to warranty claims on systems that you've upgraded. That's not to say upgrading a big-brand PC isn't possible, but if upgrades are a primary concern, they're not the best option.

WINNER:
DIY

And the winner is...

If you have money to burn, and are happy being dictated to by the PC builder, a rig from a big OEM might well be your bag. Certainly, they offer some slick and stylish options that give a very similar actual end-user experience in terms of performance compared to the other options.

But we think DIY and boutique-built PCs are a better choice for the discerning enthusiast, and in terms of the overall proposition, we're calling it a tie. Which you go for comes down to a combination of skill set and preference. The best boutique brands have a very good handle on what a well-informed enthusiast wants. They can likewise work with customers to create something bespoke and on point. And the big advantage is the comprehensive, rather than per-component, support. But, for the very last word in personalisation, a DIY rig can't be beat. And there's something special about a system built with your own hands; you'll have a closer affinity with it, a better understanding. Like we said earlier, only by building your PC can you truly know it.

PC

$3,499 | **WWW.AU.MSI.COM**

MSI Trident X

Small size, big performance.

Now that we have new CPUs and GPUs from Intel and Nvidia, those considering upgrades have some tasty new options to choose from. Not everyone wants to, or is comfortable building their own PC though and these users look for something off the shelf to plug and play. MSI has produced a gorgeous looking little PC whose compact dimensions pack in some truly high end hardware to cater to gamers looking for a powerful yet small form factor gaming rig out of the box.

The Trident X packs some beastly components into its 10 litre case. The configuration we have for review comes with an 8-core i7-9700K and GTX 2080 for starters. Add to that 32GB of memory, a 512GB NVMe SSD and a 2TB HDD and you have a system that will power through any game, even at 4K. If that's not enough, MSI offers versions of the Trident X packing a 9900K and 2080Ti. That's about as high end as it gets! There's some bloatware like Norton anti-virus we could do without though.

The specifications are one thing, but MSI has really produced a gorgeous chassis to contain these powerful components. There's a healthy dose of RGB lighting on the front and top of the case along with the CPU cooler shroud. MSI ships two case side panels with the Trident X, one of which is metal while the other is tempered glass. We'll have to ask MSI if they plan to sell this chassis separately as we like it a lot. It's not quite console size, but it's not all that much bigger either.

The use of standard components means there's some upgrade potential down the line. You could upgrade to a next-gen GPU for example, and the NVMe SSD is exposed for easy swapping. MSI has made a good choice to go with a standard air cooler which means that air is directed over the motherboard and components, greatly assisting cooling, which can be a significant weakness in SFF systems.

As we'd expect with a component set such as this, performance is strong. The 9700K provides multithreaded grunt with a Cinebench 15 score of 1438. That's better than an 8700K despite its apparent thread disadvantage. Gaming is also strong thanks to the capable GTX 2080 Ventus. *Middle Earth: Shadow of War* and *Rise of the Tomb Raider* returned 56 and 63 fps at 4k respectively. This means 1080p and 1440p gaming with a high refresh rate monitor will look a treat.

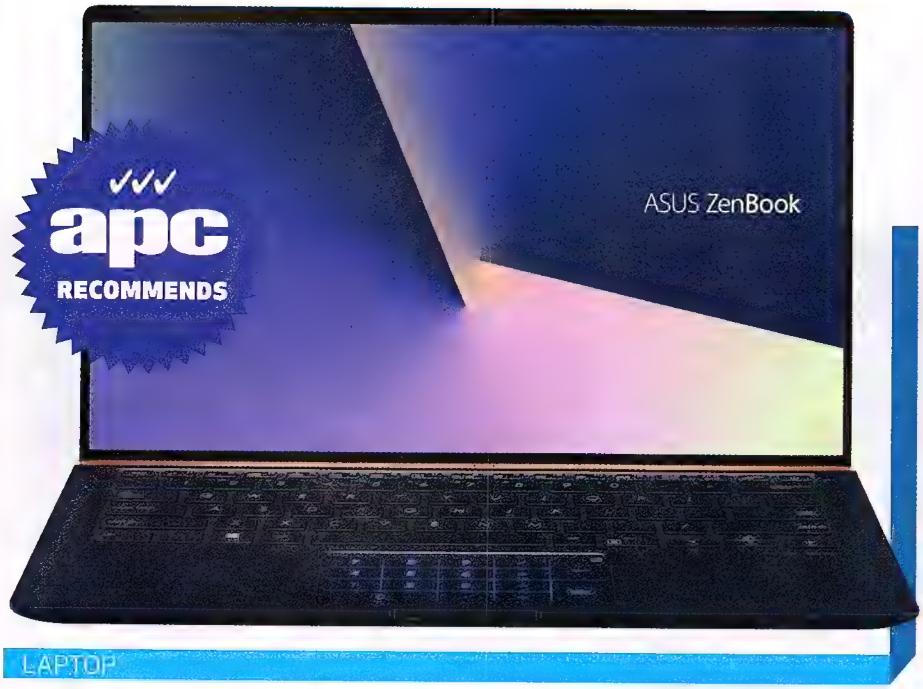
The Trident X is a seriously capable PC and is competitive at this price point when compared to off the shelf and store built PCs around $3,500. A plus is that the after sale support and the warranty process will be simplified should you ever need to claim it. Of course it's cheaper to build your own, but for many reasons, that's not as simple as it sounds for a lot of users. The Trident X is a great looking, powerful and surprisingly affordable option for gamers and users who need serious PC grunt combined with plug and play ease. ■ **Chris Szewczyk**

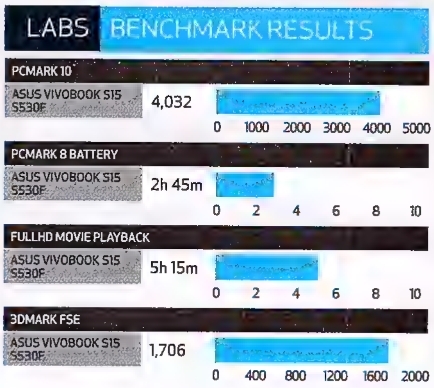
> "The specifications are one thing, but MSI has really produced a gorgeous chassis to contain these powerful components."

Verdict

The reasonably priced MSI Trident X offers bags of performance in a compact and great looking chassis.

★★★★☆





$1,488 | WWW.ASUS.COM/AU

Asus VivoBook S15 S530F

A very good all-round laptop that offers impressive portability and reasonable value.

Asus' VivoBook range is a mid-range collection of notebooks that typically offers decent value and an all-rounder feature set without specialising in any one area. This latest S15 model carries the latest 8th gen. Intel chips and Nvidia's MX150 graphics, but little else has changed.

The Full HD screen is crisp, bright and well-lit but it's not the most colourful and graphics can feel a bit washed out. However, the "NanoEdge" bezels are super-thin at just 6mm (top and sides) meaning that the large, 15.6in display fits on a relatively-small chassis. Indeed, it's only 36cm wide and 18mm deep which, when coupled with the 1.8KG weight, makes it highly portable for this category of laptop. The aluminium chassis is generally sturdy but there's still plenty of plastic trim. Our model was a sober, silver-grey but there are some funky colour variants available.

When opened up, what Asus calls the "ErgoLift" hinge raises the rear by three degrees. This gives a slightly-more comfortable typing position plus better cooling performance.

Under the hood, Intel's 1.8GHz (4.6GHz Turbo Boost) quad-core Core-i7 8565U combined with 8GB RAM and a 512GB SATA SSD to score a respectable 4,032 in PCMark 10. However, retail specs will have lesser CPUs and variable-technology hard drives. This is probably a good thing as our test unit kept crashing when set to Windows' "Best Performance" mode. We'd like to see more than 8GB RAM but we didn't experience any obvious performance stuttering caused by bottlenecks.

Graphics come via Nvidia's MX150 GPU. This can't cope with the latest blockbuster games (it only managed 1,706 in 3DMark's Fire Strike Extreme test – about 8fps) but it will still happily play popular shooters such as *Overwatch* and *Fortnite*.

In terms of usability, the back-lit, *Scrabble*-tile keyboard is well-laid out and comfortable for extensive typing. There's a number pad on the right plus (annoyingly) half-height arrow keys. The large trackpad functions as expected. An HD webcam resides in the top bezel – it provides adequate performance but isn't compatible with Windows Hello face recognition. Meanwhile, the speakers don't get particularly loud.

Connectivity consists of two USB 2.0 ports on the left with a MicroUSB slot, while on the right are USB 3.1 ports (Type-A and Type-C) plus a full-size HDMI port.

Battery life is good, but not spectacular. It played our Full HD movie for a modest five hours 15 minutes. However, we were impressed to see that it ran the PCMark battery test for two hours 45 minutes at full power: the previous generation of Intel-based laptops significantly-throttled performance when on battery power.

All in all, it's a very good, all-round laptop that succeeds in most general computing functions. The build quality and performance will see it fit in well in most environments, including school and office. At $1,488 there are certainly cheaper options at a similar size, but they tend to carry more compromises than what's available here. Ultimately, there are no worrisome weak spots and it's a great buy for most types of users. ■ **Nick Ross**

Verdict

If you are after a decent yet basic day to day PC, the Vivobook delivers.

★★★★☆

GAMING HEADSET

$349.95 | WWW.RAZER.COM

Razer Nari Ultimate

Can you feel it in the ear tonight?

Aiming to bring some physicality to the game listening experience, Razer has released a unique pair of headphones that sends cranium-rattling haptic feedback directly to your ears and into your skull.

Surprisingly, Razer's Nari Ultimate headphones offer an effect that's nowhere near as annoying as you might assume – in fact, it's rather wonderful, providing incredibly deep bass and an added level of immersion that may result in a tactical advantage during online play. Gunshots and footsteps are not only heard, but felt, meaning the listener gets a much clearer idea of where their opponent is coming from. This is all thanks to Razer's Hypersense haptic technology, which is capable of translating sound effects and general audio into touch sensory feedback. The rumbling sensation offered by these oversized cans is somewhat intense, but you quickly get used to it. Before long, you'll relish every boom and crash in order to get the drop on your rivals. Of course, the headphones are also terrific for music listening (even if we wouldn't be caught dead wearing these outside), with the cans' 50mm drivers delivering deep, punchy sound with little to no distortion. A USB dongle is embedded within the Nari Ultimate's right ear cup, which you can eject and plug into your PC, Mac or PS4 for three-dimensional THX Spatial Audio at a wireless range of up to 12 metres, and a 3.5mm cable for stereo sound is also included for those who wish to go direct to the source. You also have a retractable mic with controls to balance game and chat audio. ■ **Stephen Lambrechts**

Verdict

Better than they have any right to be, delivering a totally new audio experience.

★★★★☆

USB-C TO USB-C CABLE

$49 | VOLTACHARGER.COM

Volta XL USB-C cable

The third-party return of MagSafe.

When Apple introduced its 12-inch MacBook in 2015 it was the beginning of the end for its proprietary MagSafe charging cable. Australian cable manufacturer Volta, however, is keen to resurrect its key features while also bringing some other bells and whistles to the table.

The Volta XL is a USB-C to USB-C cable, although one of the ends stays in your device and attaches magnetically to the rest of the cable. This means you ideally won't pull your device off the desk if you accidentally trip on the cord, and makes it very easy to plug back in, although it's not without issue. While the single included USB-C tip is great to leave in your primary device, you will quickly realise how limiting its proprietary nature is if you have multiple devices, and further tips cost $14 apiece.

Aside from this headline function, the cable features an indicator light that tells you whether or not it's charging, supports fast-charging, can share charge on-the-go (for example, from a phone to a Nintendo Switch), and is seriously heavy-duty. In fact, the company promises its cables are 10 times stronger than any other cable on the market and offer a lifetime warranty as a result. It's worth mentioning that while the cable does support data transfer, we had issues getting it to run with a Thunderbolt 3 display, so it's worth checking with your specific needs.

Considering the current cost of USB-C to USB-C cables ($29 from Apple), the Volta XL is a decent alternative even if you don't consider its magnetism. ■ **Harry Domanski**

Verdict

A welcome return of magnetic cable attachment.

★★★★☆

WIRELESS SPEAKERS

$699 | AUDIOENGINEUSA.COM/FIND-A-STORE

Audioengine A5+ wireless powered bookshelf speakers

Being an audiophile has never been so convenient.

Ever since portable Bluetooth speakers started pumping out deceptively decent audio, the space for small-form hi-fi has been narrowing. As such, it takes quite a lot to stand out in this category, but the latest from Audioengine manages to do so admirably by adding a twist of wireless convenience to these audiophile bookshelf speakers.

Available in black, white or bamboo (for an extra $100), the A5+ speakers are stylishly sleek and offer an understated, clean facade. This, in combination with their relatively compact size, allows them to blend comfortably into most modern decors, looking equally at home on a computer desk or the titular bookshelf.

The front panel of the master, left speaker offers a single dial that adjusts volume or puts the pair in a power-saving sleep mode – the same controls (plus a mute button) can be found on the remote. All other clutter is relegated to the rear of this powered speaker, with an attachable antenna, Bluetooth pairing button, power switch, RCA and 3.5mm inputs, and the connections needed to link it to the right speaker. For most users, this will be enough in the way of inputs, offering the means for one or two fixed devices with the added flexibility of a Bluetooth connection.

After the painless set-up process, you'll be pleased to know that the A5+ perform spectacularly at their primary function, effortlessly filling small-to-medium rooms with stunning audio. The unit's built-in amplifier and 24-bit DAC (Digital to Analog Converter) makes for impeccable clarity and power whether the signal is sent digitally via Bluetooth or through the analog RCA and 3.5mm connections. The antenna offers increased range and a high tolerance for interference, and when tested in our Bluetooth-heavy environment we experienced no stutters, drop-outs or loss of quality. Audioengine claims to have specially tuned these speakers to excel when playing the compressed and lossless files often found on mobile devices and streaming services (MP3 and AAC for example) and we have to say it works a treat. The produced frequency profile is very pleasing and, despite a slightly mid-forward sound overall, the treble is still present without being harsh and the bass is punchy without booming. Considering the size of the main woofers (5-inches), the low-end response is surprisingly powerful and clear, although you can hook up a subwoofer via the RCA output if you feel you need to really feel those sub-100Hz frequencies. The A5+ produce a distinctly hi-fi signal regardless of whether they're dealing with your favourite film, game or movie, and even offer a decent platform for music production, although their lack of quarter-inch inputs may not gel as well with the latter.

While you can save $100 by grabbing the wired version, we think that the A5+ Wireless are worth the extra dosh and sit at a reasonable price given their awesome audio quality and wireless capabilities. ■

Harry Domanski

Verdict

A compelling reason to upgrade from portable Bluetooth speakers.

★★★★★

ROUTER

$400 | WWW.DLINK.COM.AU

D-Link Viper 2600 MU-MIMO Modem Router

What it lacks in features it makes up for in performance.

Car enthusiasts will tell you that when a top-of-the-line sports car is stripped down of its leather seats, aircon and other luxury features to become a slightly-faster racer, the manufacturer counterintuitively charges more for it despite you getting less. D-Link's Viper has that feel about it. On the one hand, it's a $400 old-school router, with basic firmware and few of the flashy advanced features that we've seen elsewhere. On the other, the technology within has been amped in an effort to significantly-boost performance.

One of the headline features is D-Link's beamforming technology which uses a single network to dynamically switch devices between the 2.4GHz and 5GHz bands. This ensures that range and QoS are optimised and that devices utilising high-performance applications (such as online games and 4K video) aren't delayed by lesser devices on the network. MU-MIMO technology is cited but we've never registered any real-world benefits from it. More important is the dual-core processor which, theoretically should be a high-performance enabler. This all works using AC2600 speeds spread across four data streams.

However, years of testing Wi-Fi has made us sceptical about such claims so we ran torture tests to see how they stacked up. The first was a basic range test. We used our 115/5 Telstra cable internet connection on the ground floor of a Sydney townhouse and ran Ookla's Speedtest on an iPad Pro: up close, then one floor up in a bedroom and then two floors up. Up close, it maxed out no problem. One floor-up it only dropped to 89Mbps down which is double the speed of most rivals. Two floors up it was still able to score a solid 25.6Mbps – a location where most rivals struggle for any reliable connection.

So far so good. But this router claims to be able to handle much more. Consequently, we set our TV watching *Narcos* in 4K on a wired connection. Near it, we set an old, slow Android tablet watching children's videos on YouTube. Two floors up we watched Amazon's *The Grand Tour* in HD on an iPad Pro and YouTube's 60fps 4K Costa Rica video showreel on a top Android smartphone – all the while playing an online Steam FPS game on a PC connected through a powerline adapter while it simultaneously downloaded another game via Blizzard's gaming app. The Viper didn't even flinch – everything ran smoothly.

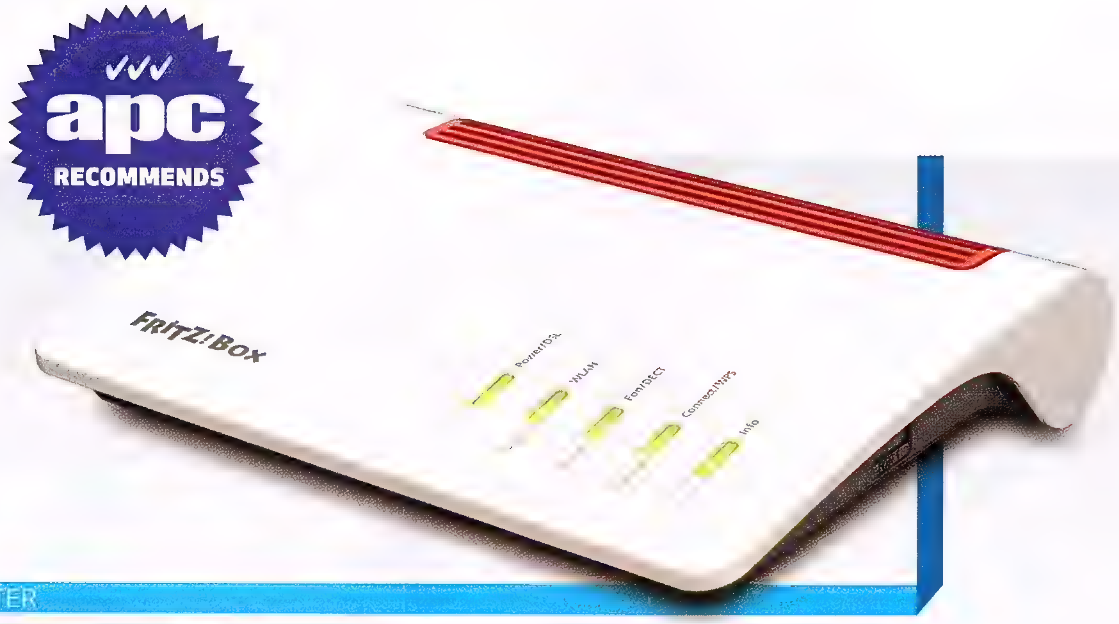
Other features are modest. Physically, there's an in-built modem with RJ-11 port that's compatible with the NBN network. However, there's also a WAN Ethernet port (to complement four Gigabit Ethernet ports) so that it will also work with existing modems. There's a DLNA-compatible, front mounted USB 3 (Type-A) port for sharing media across a network plus two fiddly buttons for WPS and enabling Wi-Fi. Meanwhile, the router's firmware is very basic. There are the usual security, filtering and forwarding features but little else. Remote management involves network configuration instead of an app. At $400 it's not cheap, but if your requirements are performance related, this is the fastest router we've seen.

Nick Ross

Verdict

No frills, but what you get is supremely fast Wi-Fi performance.

★★★★☆



ROUTER

$477 | WWW.FIRSTINT.COM.AU

Fritz!Box 7590

Expensive but also the most feature-packed and telephone-friendly home/SMB router on the market.

At a time when wireless routers resemble objets d'art and are set up via apps, we became nervous when the Fritz!Box showed up: old-school-looking routers like this could be difficult to get going and operate reliably. However, Fritz!Box has attracted a sizeable online community of power users to whom one touch router set-up is an anathema. So what makes them special?

Not the looks. The vibrant colour splash and curvy sides are lipstick on a pig now that we're used to rivals' living-room friendly spaceships and sci-fi prop-like designs. Rotating it gives some clues: there's both the usual WAN port and four Gigabit Ethernet sockets plus a vDSL socket, two analog phone sockets plus an ISDN port. That's in addition to two USB 3.0 ports that support printers, storage and 4G dongles.

The vDSL port is compatible with supervectoring speeds of up to 300Mb/s. While this isn't available in Australia yet, the nature of our country's calamitous NBN network means that it may be useful in future years.

It can act as a base station for up to six DECT telephones too. Buttons on the front control Wi-Fi (on-off) plus WPS W-Fi connect plus Fon/DECT device connections. The latter can be used to connect other Fritz! Smart devices. This is just the hardware.

Setting up is actually very simple: just go to **fritz.box** and enter the details that are stuck to the router's base. This gives you access to a Linux-based operating system that resembles traditional router layouts, only with far more features. You can even access it via mobile app.

One feature is Fritz!NAS which is a far better laid-out and responsive application than seen on competitors. Another is the answerphone which can email you with missed calls. There are plenty of phone-routing options too, with the ability to block and divert numbers.

We're impressed with the intuitive navigation: there are plenty of overview pages where you can easily see exactly what's happening on your network and navigating through pages is quick and responsive. All manner of filters, monitors and device management are available along with everything you'd expect from a fully-specced home/SMB router. There's also a well-featured media server which can handle internet podcasts and web radio.

In terms of performance, it offers eight internal antennae plus 802.11ac MU-MIMO technology. We tested its Wi-Fi range using Speedtest.net on a 115/5Mbps Telstra cable connection and an iPad Pro. Up close it maxed out easily. One floor up it dropped to 26Mbps download which is weaker performance than we've become used to from large, spikey, rival flagships. Another floor up and it managed 10Mb/s download but failed the upload test when it lost the connection. So, performance is more last-generation than competitors, but at least this can be fixed with the addition of a mesh system or extender.

At around $500 it's very expensive and overkill for most buyers. However, if your office needs the reliability and features, or if you're a hardened networking enthusiast, there's great value to be had. ■ **Nick Ross**

Verdict

Not for everyone, but if you want advanced features and reliability this will appeal to many.

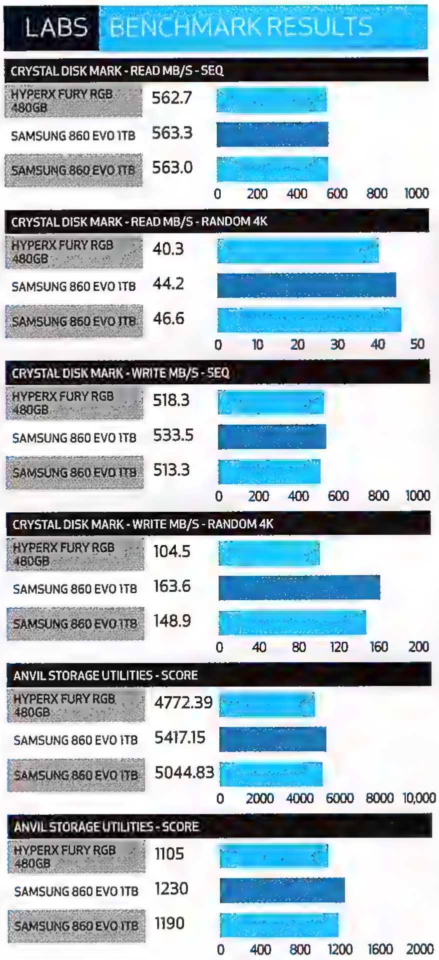
★★★★☆

SSD

$175 | WWW.HYPERXGAMING.COM

HyperX Fury RGB 480GB SSD

Have we hit peak RGB?



RGB has become so omnipresent that it was only a matter of time before SSD manufacturers began producing RGB SSDs. Love RGB or loathe it, at the end of the day aesthetics are important to a lot of people. If there's a demand, so shall it be. Why settle for a drab black or grey SATA drive when you can have something that looks great with the rest of your system? The HyperX Fury RGB SSD is tailor made for users who place looks at the top of their criteria list.

The HyperX Fury 480GB is a 2.5In SATA 6GB/s SSD that's a non-standard 9.5mm in height. This makes it unsuitable for use in a laptop, though this is basically irrelevant given its purpose. This is a drive you buy for its superb looks. Kingston doesn't provide many details regarding the specifications or component specifics of the drive but we do know that the Marvell 88SS1074 controller is widely used among budget SSDs, so we don't expect top end performance from the Hyper X Fury. We're a little disappointed at the HyperX Fury's three-year warranty as most manufacturers are moving to five-year warranties.

The undisputed highlight of the Fury SSD is its RGB functionality. It comes with a mini-USB to 4 pin RGB cable that allows you to connect the SSD to the 4 pin RGB header on many gaming motherboards. It can be daisy chained too. If you're looking at an RGB SSD, the chances are it's far from the only device that you'll be needing to control! If you don't plug it in, it will default to a red colour. The RGB LEDs can be controlled by all the major motherboard manufacturer's software control applications. Overall the lighting is bright and vibrant. The drive itself also looks great, with a solid metal finish that's befitting of a drive that focuses on aesthetics.

So we know it looks great, but how does it perform? The Fury RGB's performance is middle of the road. The likes of the Samsung 860 Evo and Crucial MX500 perform better, but it's not like the Fury RGB is a slug. It will do its job well, and function particularly well as a game library SSD. Its decent, if not terribly exciting read performance makes it well suited for that kind of use case where you're likely to be using an NVMe SSD as the Windows drive.

At around $175 the Fury RGB is a lot of dollars compared to the significantly cheaper and better performing non-RGB competition. If it wasn't for the RGB functionality we'd rate the Fury very poorly, but that's not what this drive is about. It's unabashedly designed to show off in a windowed case. So what if it costs a few 10s of dollars more? It serves a specific purpose and does it well. If you're not interested in showing it off, of course you shouldn't be looking at this drive in the first place. ■

Chris Szewczyk

Verdict

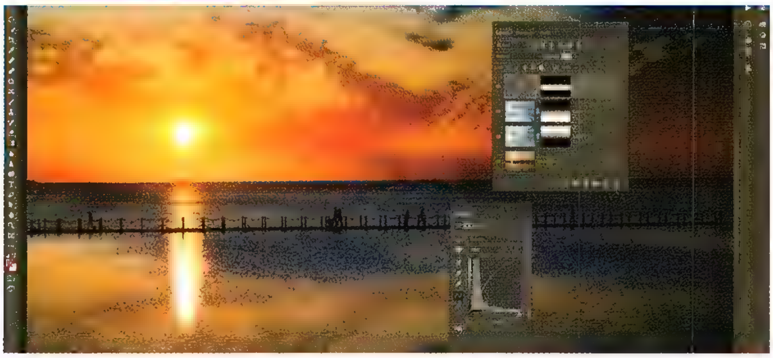
The Fury RGB serves its aesthetic purpose well, but don't expect great value or record breaking performance.

★★★★☆

software

» APPS FOR ALL YOUR PLATFORMS

Windows SOFTWARE



Photoshop CC 2019

Is this still the best photo editor in the world?

FROM $14.30 PER MONTH | WWW.ADOBE.COM/AU/

Photoshop CC is only available with a Creative Cloud subscription, which will put some people off straight away, but Adobe's Photography Plans start at $14.30 per month. This entry tier gets you Lightroom and 20GB of online cloud storage, but you can bump that up to 1TB of cloud space for $28.60 per month. For novices and enthusiasts there are smarter (non-subscription) alternatives to Photoshop, but for photography pros, Photoshop is practically a required skill.

Photoshop also has some of the best tools in the business for retouching, cloning and 'content aware' object removal, and Photoshop CC 2019 brings a dedicated workspace for choosing source pixels and outputting the results on to a new layer for more effective editing and blending.

Photoshop CC is typically updated a couple of times a year (it's all part of your subscription, of course), but the number of updates directly relevant to photographers does seem to have slowed.

The latest October 15 2018 update brought the new Content Aware Fill workspace, a redesigned homepage with access to recent files, training materials and Lightroom CC profiles, live previews of blend mode changes and not a whole lot else.

The clever new Select Subject option arrived in January 2018, together with a slider to control decontamination around selection edges (whoop!), and before that in October 2017 Adobe introduced 360 editing tools, depth map support for HEIF files and smattering of other enhancements and improvements.

In fairness to Adobe, it's hard to see how much more can be added to Photoshop to make it genuinely better, but the pace of change is underwhelming nevertheless.

The current Photoshop CC feels very fast on the 2017 iMac with 16GB RAM that we used for testing. Some processes will slow it down, and one of the key selling points of Affinity Photo, its keen rival, is sheer speed, but for most everyday operations, Photoshop's speed was not an issue, even with the 50MP images from a Fujifilm GFX 50R that we were using.

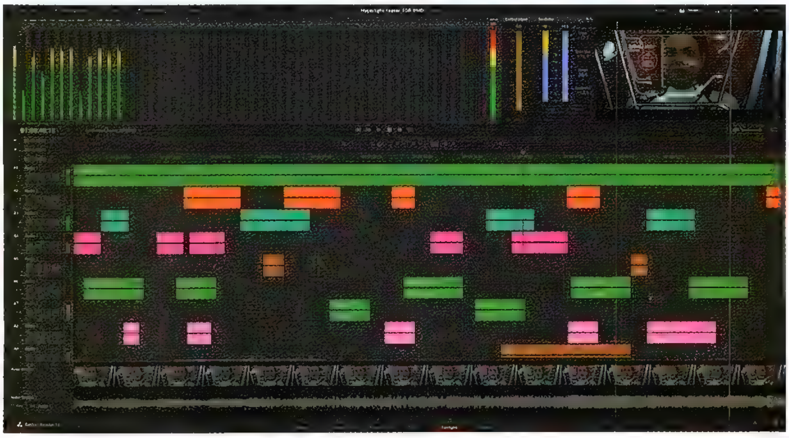
The current edition is as slick and efficient as ever.

Rod Lawton

DaVinci Resolve 15.2

DOES THIS POWERFUL ALL-IN-ONE VIDEO EDITING PACKAGE MEET YOUR NEEDS?

FREE, STUDIO US$305 | WWW.BLACKMAGICDESIGN.COM/PRODUCTS/DAVINCIRESOLVE/



Since BlackMagic acquired DaVinci Resolve, they've made some serious modifications to it, to the point that it can now be considered a strong contender for video editing, colour grading, special effects and sound mixing. Not only does it land at an extremely affordable price it'll work on your platform of choice, be it Mac, Windows or Linux.

BlackMagic offer a free version, which caters for most needs of a budding (and not so budding) editor. There are a few functions missing, but you can't beat that price for a very stable and powerful tool. Studio, the paid version, offers more effects and templates, and among others, the ability to edit in 4K and up to 120fps, in addition to more under the hood performance improvements. Unlike Adobe, who expect you to fork out for a monthly subscription to use their wares, DaVinci Resolve Studio is yours for a one-off fee, just like Final Cut Pro. You pay US$305 for a licence and all future upgrades, including the major ones, are free. ■

RapidWeaver 8

A favourite website builder gets better.

US$99 | REALMACSOFTWARE.COM

RapidWeaver enables you to create a professional-looking website even if you're an absolute beginner. And while it's as user-friendly as any Apple app, there's plenty here to delight power users too. With version 8 it introduces some important new features that make it better than ever.

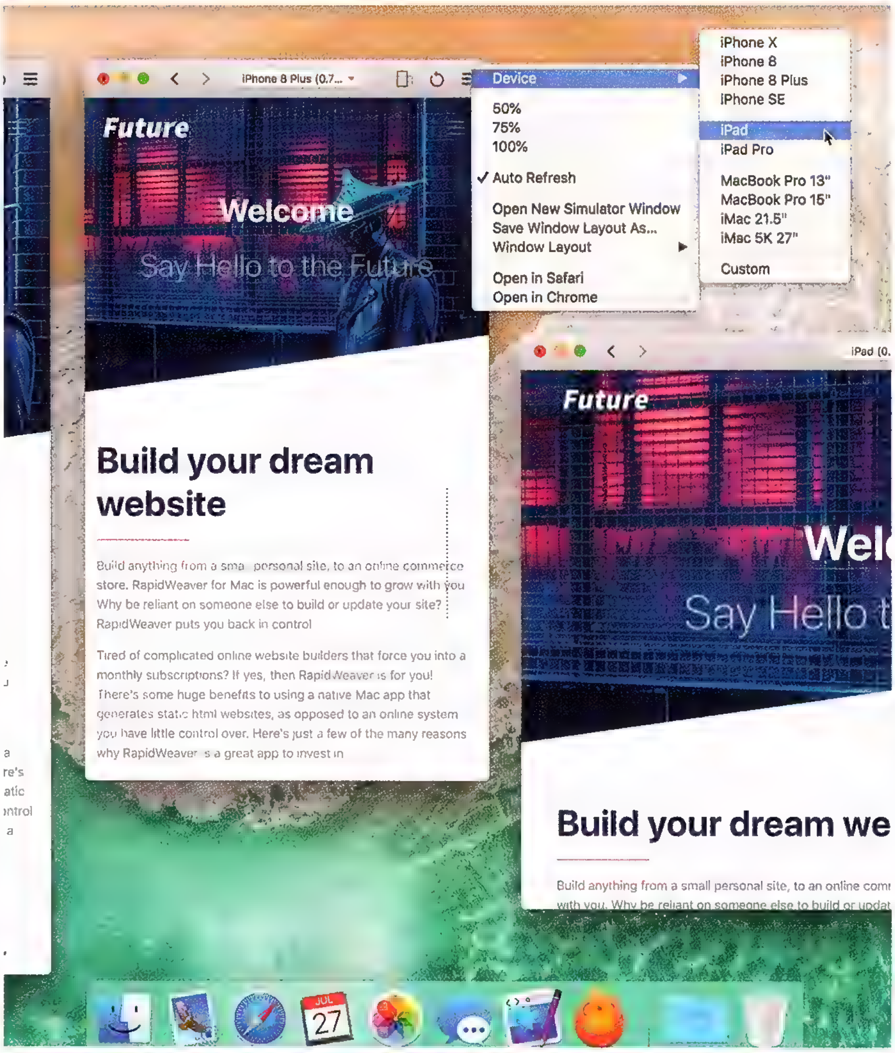
First off, the redesigned interface is more streamlined and modern-looking, but the core design hasn't really changed. If you're a seasoned RapidWeaver user you won't find it strange or startling – but you'll love the fact that the app now saves your window setup, so it's ready to go when you next open it.

As before, RapidWeaver is built around templates. There are five new ones here, including the pretty Artful and the crisp Future, and once you've chosen a theme you can add new pages with a click in the sidebar. You can switch between viewing and editing modes, and in the latter you can replace the boilerplate text with your own, as well as add items, such as metadata for search engines. Version 8 also lets you automatically add titles and descriptions for improved social media sharing.

SIMPLE OR COMPLEX?

RapidWeaver can be as simple or as complex as you like. If you just want to edit the template text and publish, you can do that: there's an integrated FTP uploader so you don't need an extra app. If you want to add your own CSS or HTML code, or take advantage of the massive library of plugins that add extra features to the app, you can do that too. The new Addons Manager makes it easy to toggle add-ons and back them up, and the new Resources Manager provides a simple way to manage such assets as images and files. You also get access to Unsplash, a free online photo library integrated right into the Resources Manager.

One of our favourite new features is Device Simulator, which enables you to see just how your site will look on anything from an iPhone SE to a 5K iMac – and not just in portrait mode, but in landscape too. That's important if you're designing for mobile devices in addition to desktop. It's live, too, so edits are shown in the Simulate window in real time.



Build your dream website

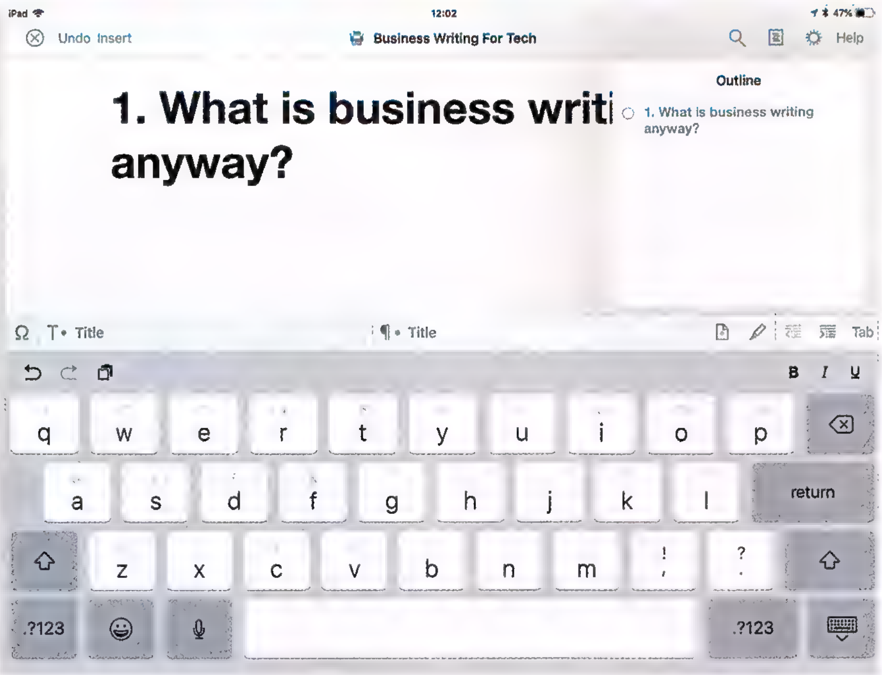
Build anything from a sma personal site, to an online commerce store. RapidWeaver for Mac is powerful enough to grow with you Why be reliant on someone else to build or update your site? RapidWeaver puts you back in control

Tired of complicated online website builders that force you into a monthly subscriptions? If yes, then RapidWeaver is for you! There's some huge benefits to using a native Mac app that generates static html websites, as opposed to an online system you have little control over. Here's just a few of the many reasons why RapidWeaver is a great app to invest in

> "Device Simulator enables you to see how your site looks – it's live, too, so edits are shown in real time."

RapidWeaver has long been our go-to app for building websites on Macs, and with version 8 it really is better than ever. Whether you're working on a blog or a website for your business, you'll find web design doesn't get much easier than this.

Carrie Marshall ■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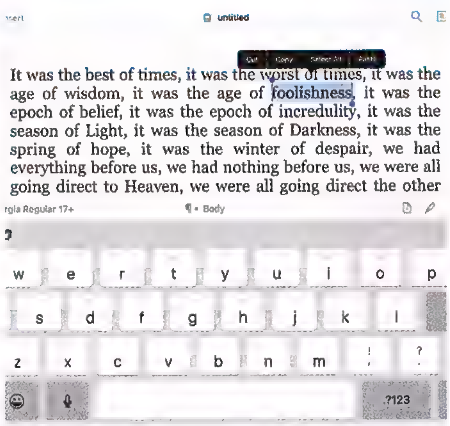
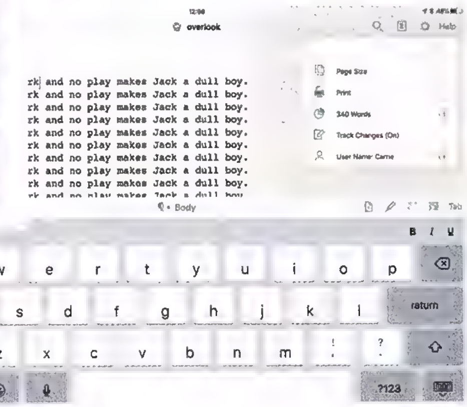


It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other



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Mellel for iPad

A word workhorse in iOS form.

$30.99 | MELLEL.COM

Mellel is loved in academic and technical writing circles. It excels in the crucial tasks of structuring documents, creating indexes and tracking citations – things that Microsoft Word hasn't been very good at. It's very fast and very stable, and while it takes a bit of getting used to, it's an excellent workhorse if you write text-heavy documents for a living.

While Mellel has been available on the Mac for years, the iPad edition is relatively new. It's been designed to work in conjunction with the desktop app and clearly expects you to do the bulk of your work on that. So, for example, while you can easily apply styles, you can't currently create new ones. Similarly, you can edit the content of text boxes, but you can't add them to documents inside the iPad version. We like that indexing updates as you go, but then it's disappointing that the table of contents doesn't follow suit.

The interface is clean and generally well thought out, but there is one incredibly annoying interface decision that we initially thought was a bug. Normally when you select a word in an iOS app, you can then expand your selection by moving the selection handles. Similarly, when you want to resize an object, you select it and then tap and drag the resizing dots on its edge or corner. With Mellel, however, those behaviours don't work. To select more than one word you have to press and hold your finger down before the selection handles become movable; to resize an image you need to long-press on the resize points. It's really not a user-friendly approach.

EXPORT LIMITATION

The other problem is that the iPad version reads Word file formats but doesn't export them. Like it or loathe it, Word is the default in many businesses and many writing jobs. We've just completed several large book projects and a lot of corporate copywriting, and in every single case Word wasn't just preferred, it was demanded. In many cases that's because the client or internal readers use the commenting and change-tracking features; while Mellel on iPad has those features, lack of Word export means they're only available to other Mellel users. The developers clearly assume that you'll be submitting your work from the desktop app.

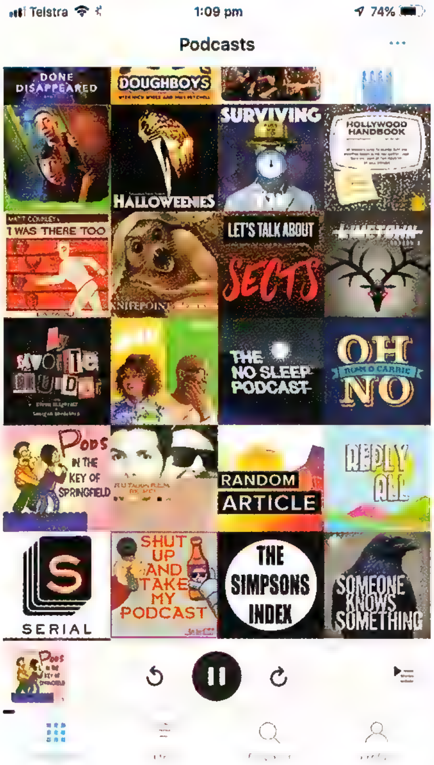
If you're already a Mellel user on your Mac then the iPad edition is a useful companion. As a standalone word processor, however, we feel that it's too limited to appeal to most. ■ **Carrie Marshall**

Pocket Casts

Podcasting's best app gets a major update.

$5.99 | N/A

It's been two years since the last major Pocket Casts update, and now, with version 7 upon us, the idea of sticking to Apple's standard podcast app is more ludicrous than ever. Pocket Casts – developed in Adelaide, Australia, for what it's worth – now lets you search for individual episodes and play them without subscribing, which was really the only major thing that the app was missing previously. It's had a full makeover too, meaning that Pocket Casts is now better to look at and considerably less clunky to use. In addition to everything we've always loved about the app – the ability to skip silences, the listing features, its clean design – you'll now be able to access your listening history, search more easily for individual episodes, and use Siri shortcuts if you're on an iPhone. The Discovery page's curation algorithm has also been rejigged. Yes, Pocket Casts costs money, but for $6 you're getting an app that is significantly better than the various free podcast apps out there. ■ James O'Connor

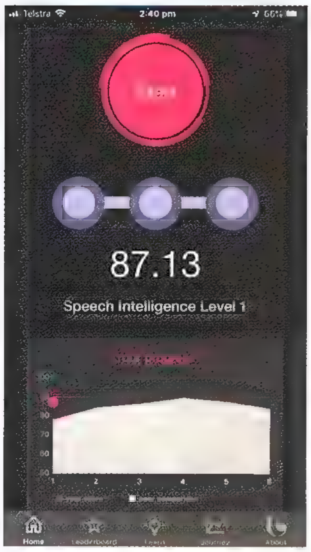


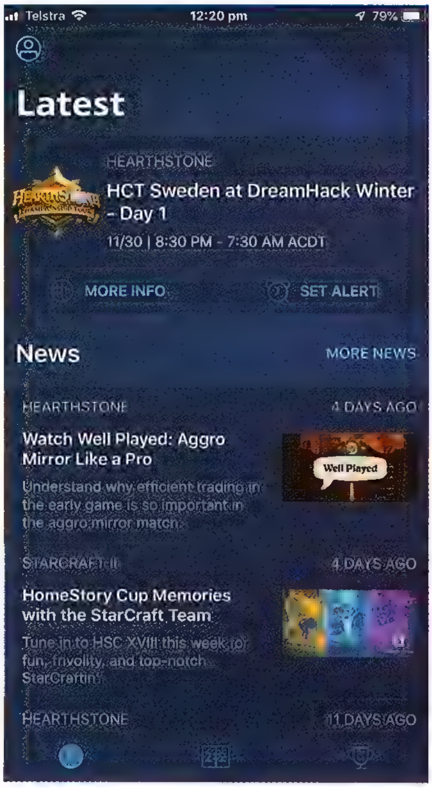
Gweek

Talk more better.

FREE | GWEEKSPEECH.COM

Knowing how to present yourself and speak effectively is important in just about every field of work, but a lot of people struggle to get their cadence right, or to not splatter their sentences with 'ums' and 'ahs'. Gweek is designed to help you with the difficulty of not sounding like an idiot when you open your mouth, and it does a decent job of it. The app gives you a topic, asks you to speak on it for two minutes, and then spends a few minutes analysing your speech patterns to advise you on how to speak more clearly. After a few sessions, though, I'm not convinced that this is an app I'll return to in the future or use for long-term improvement – asking you to speak on a random subject can lead to rambling, and when my score rose or dropped it was hard to gauge what had caused it. It's an interesting app, though, especially for people who struggle with public speaking – its advice and coaching could well help you. ■ James O'Connor





Latest

HEARTHSTONE
HCT Sweden at DreamHack Winter – Day 1
11/30 | 8:30 PM - 7:30 AM ACDT

News

HEARTHSTONE 4 DAYS AGO
Watch Well Played: Aggro Mirror Like a Pro
Understand why efficient trading in the early game is so important in the aggro mirror match.

STARCRAFT II 4 DAYS AGO
HomeStory Cup Memories with the StarCraft Team
Tune in to HSC XVIII this week for fun, frivolity, and top-notch StarCraftin'

HEARTHSTONE 11 DAYS AGO

Blizzard Esports

Track all the action.

FREE | HTTPS://ESPORTS.BLIZZARD.COM

The Blizzard Esports app is a hub to keep you in the loop on all the big upcoming Blizzard esports events. When you first load it up you can nominate which games you're interested in – from *Hearthstone* and *Overwatch* right through the old-school original *Starcraft* – and the app will curate news and events that are likely to be of interest to you. You can set alarms for upcoming games so that you don't miss out on them and choose whether the app will display scores and outcomes of matches or whether you'd rather not have them spoiled. It's a comprehensive tracker for all of Blizzard's esports events, so fans should find plenty of value in it. There doesn't seem to be a way to watch videos natively within the app right now, meaning that you'll have to jump out of the app to see *Hearthstone*'s upcoming 'Winter Playoffs', but it gets the job done and should help you keep on top of the comings and goings in Blizzard's various esports leagues.

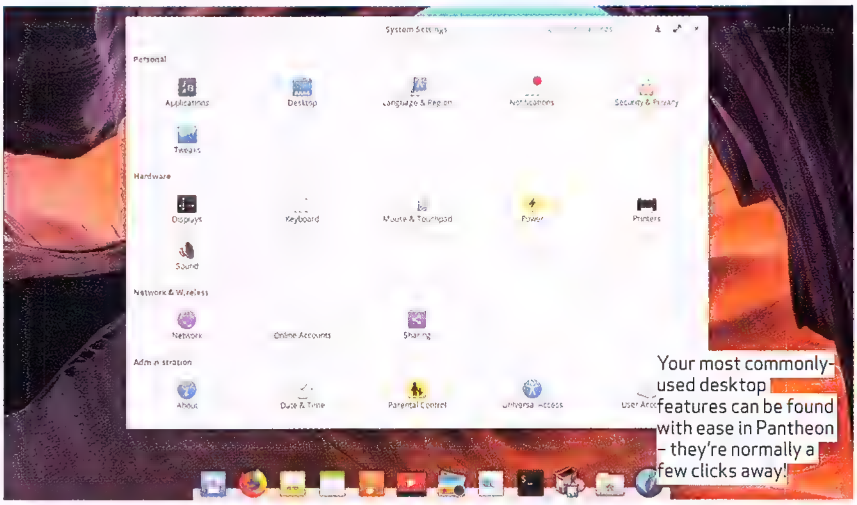
Pantheon

Alexander Tolstoy considers the Pantheon desktop environment.

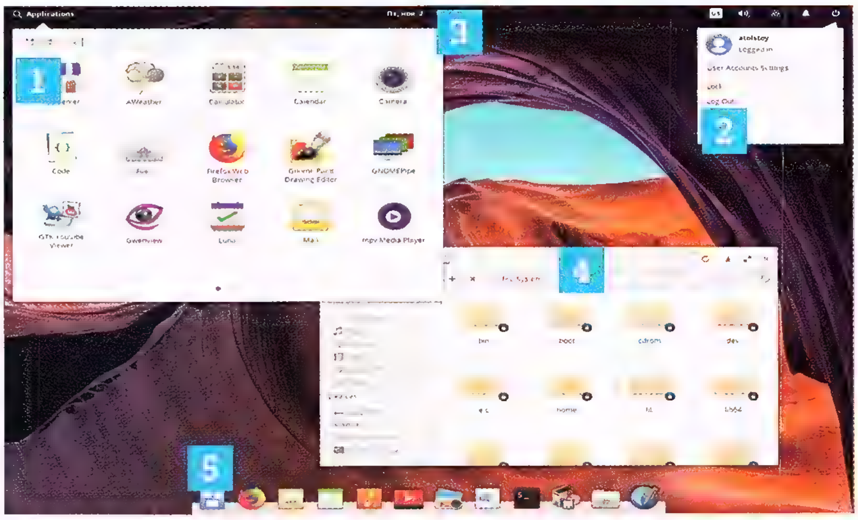
FREE | HTTPS://GITHUB.COM/ELEMENTARY

A lot has been written about the release of Elementary OS 5.0 'Juno' in general, but little about its killer feature – the shining and adorable Pantheon desktop environment (DE). In the meantime, this DE is not soldered in to eOS, but instead is available as an independent software stack for everyone. Pantheon has gained many devotees thanks to its sleek, lightweight and fully-featured DE with its own file manager, control panel, bars and panels. It was forked from Gnome 3 but evolved into an original thing with its own GUI library (Granite) that extends GTK3.

The key components of Pantheon are: the Plank dock; the Switchboard settings panel; the Wingpanel top bar; the Slingshot app launcher; and a bunch of crafted accessories such as a code editor, file manager, webcam photo booth and more. The desktop looks and – to a large extent – behaves like the macOS GUI (there was even an option to enable the magnifying effect for Plank, although this was canned due to a patent infringement with Apple). Pantheon is the cornerstone of Elementary OS – without it, eOS would be just another Ubuntu LTS spin-off with a controversial AppCenter on top. However, there are plenty of Linux users who wish Pantheon was running on top of other Linux distributions. Currently, there are plenty of ways to fulfil that demand. We have Pantheon for Fedora (look for Decathorpe repo in Copr) and Debian (**gandalfn.ovh/debian**) in very good shape, and experimental builds for many other Linux flavours such as Arch (**pkgbuild.com/~alucryd**). Pantheon outside eOS runs just fine and the only visible difference is that you will have your native package management software instead of AppCenter. Using the desktop is easy and fun, giving you all the benefits of Pantheon such as auto-saving in Code, a very fast and fluid Terminal app, nice system tray animations and more. Most of the curated apps that have been designed for eOS can be manually obtained from their GitHub pages and compiled using Meson and Ninja.



Your most commonly-used desktop features can be found with ease in Pantheon – they're normally a few clicks away!



1 THE SLINGSHOT MENU

This is a one-stop for searching and launching all installed applications. A list view option is also available.

2 THE USER MENU

Very similar to the one found in Gnome 3, the Pantheon user menu sits next to notification icons. There is also a quick link to system settings.

3 THE WINGPANEL BAR

A top panel with a HUD-like clocks and a calendar in the middle. The Wingpanel bar can adapt its colour and transparency to a maximised window.

4 THE PANTHEON FILE MANAGER

A simple, macOS Finder-like application with header bar, tabs support and an appealing design. Does not differ too much from Nautilus.

5 THE PLANK BOTTOM PANEL

Obviously, a clone of the macOS dock. It starts with a multi-tasking icon, contains pinned apps, supports groups and folders and automatically hides itself away when a window is maximised.

17

Perfect video playback

Neil Mohr takes you on a tour of video codecs for the ultimate theater-quality experience.

Why is playing video so complicated? Why does it play smoothly in one program, but not another? Why can you play it on this system, but not that one? Why does it stream OK, but not play locally? How can the video play, but not sound? How do you get subtitles to display? Why is the audio only in stereo, not surround? How come the colors are drab? All those questions have come from the mouths of people who had the audacity to try to play video on their PC.

Before you throw your PC out the window, we're offering you a masterclass in video playback. We'll explain the complexities of the Windows video pipeline (you'll see why things can become so difficult to diagnose), and discuss what software you need to get the best playback without the hassle, along with how to install and tweak it to perfection. Along the way, we'll see what hardware acceleration you can use, discuss the madness of the codec world, ensure sound isn't neglected, and cover 4K and HDR content, too.

You could very easily argue that local video playback has become redundant anyway, because streaming services have pushed content online, and that's where most people consume their entertainment. We're not going to argue with that, but if you still want to retain ownership of your paid-for movies and video, the only true way to do so is to have a local copy, otherwise you're really only borrowing it from a copyright holder under the guise of a license. We don't want to get bogged down in the philosophy of it all, so instead we're going to get bogged down in codecs – this should be fun....

There's no such thing as a video player. Anything you think is a video player is actually just an elaborate black box, which happens to pull together a host of functions and features to make a moving image appear on your screen and audio pour out your speakers – all at the same time, incredibly, and in sync, down to the millisecond.

To understand how that black box works, we'll kick things off by taking a look at what goes into the video pipeline, from source to target. This will help us understand how the various elements plug together to decode, manipulate, and output our video and audio. We can then drill down into the individual blocks of the pipeline, and explain how to get the best from each part, and what's really needed.

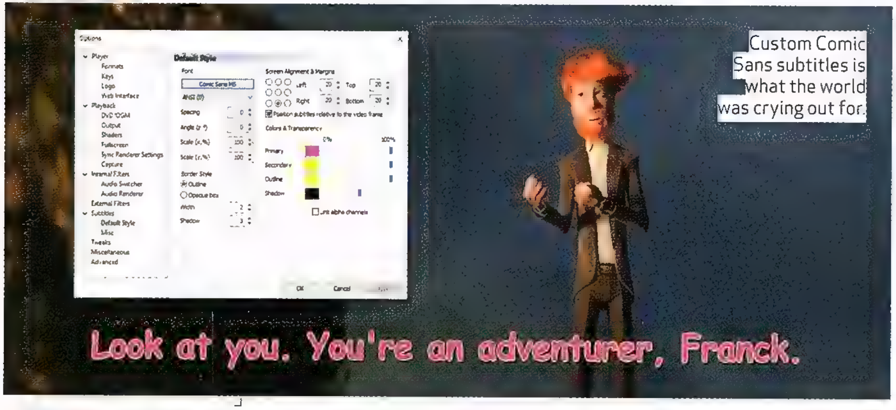
The language used tends to be flexible. Microsoft DirectShow is the Windows system used to manage the flow of video data, and it refers to codecs as filters—largely because "codec" is a redundant term, as it means "(en)COderDECoder," and in this context, they're largely just decoder filters. We'll cover different terms as we come across them. Alongside that, read the "Just Get This…" box, and grab the suggested codec pack, plus Media Player Classic (MPC) from **https://mpc-hc.org**, to ensure we're all using the same software whenever we talk about settings and so on.

At the start is the source. That's usually a single video file, but even this is complicated. When dealing with a player such as MPC, you can specify separate video, audio, and subtitle files, and it combines them into a cohesive output. Video and audio tracks in MPC are loaded via "File > Open File," with subtitles loaded via "File > Subtitles," though subtitles contained within a file are controlled via the Demux and Subtitle filter, which we'll come to.

These days, a single video file is actually a container file format. Famously, there's AVI, MP4, and MKV. Ideally, a container format should offer a flexible way for a single file to contain multiple video, audio, and subtitle tracks. This largely explains the rise in popularity of MKV; it's open source, and supports almost all the features you could want, over and above AVI and MP4.

Before we can do anything with the container file, we need a filter that can split the various parts into separate streams. This is called demultiplexing, or the Demux stage – a more layman's term is a splitter. If you're following our advice in the "Just Get This" box, it's the LAV Splitter – other splitters exist, such as the Haali Media Splitter. Settings (via the LAV Splitter preferences) can largely be set to default here, unless you happen not to be an English speaker, in which case you need to specify your preferred language for any audio and subtitles, so they can be picked up automatically if available.

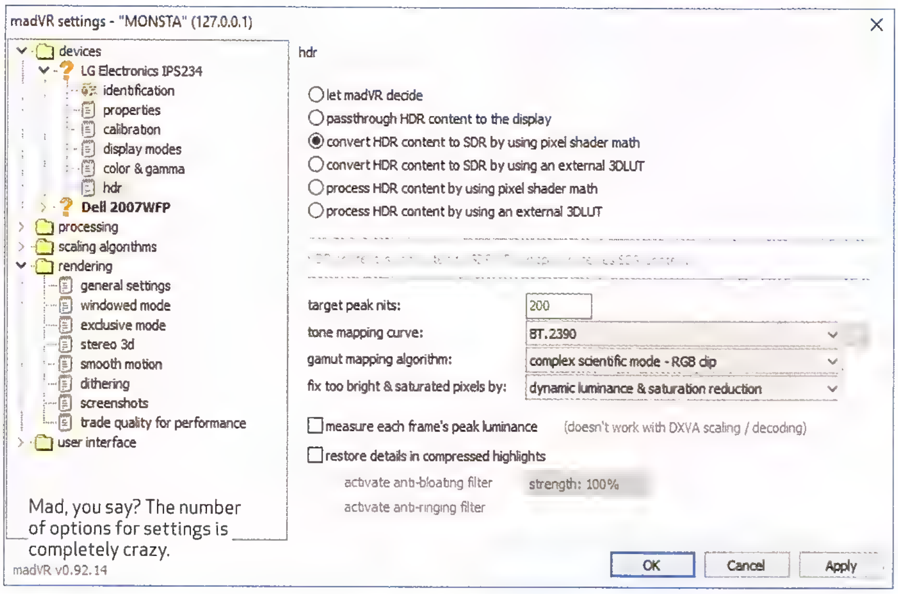
Compare the output of HDR content with and without processing.


Custom Comic Sans subtitles is what the world was crying out for.

Default Style
Font: Comic Sans MS
Spacing: 0
Angle (z, °): 0
Scale (x, %): 100
Scale (y, %): 100
Border Style: ● Outline ○ Opaque box
Width: 2
Shadow: 3
Screen Alignment & Margins: Left 20, Top 20, Right 20, Bottom 20
☑ Position subtitles relative to the video frame
Colors & Transparency: Primary, Secondary, Outline, Shadow
☐ Link alpha channels

SUBTITLES

We're going to tackle the subtitle stream first, as it's quite straightforward. Subtitles can be internal ones or external ones you've downloaded – for the latter, these are just text files with timestamps and translated lines. And, yes, you can create your own comedy ones if you like. K-Lite uses the long-standing DirectVobSub filter, which offers placement, typeface, aspect ratio, and loading controls. It looks for suitably named subtitle files in the same folder as the video file, in a "\subtitle" folder alongside the video file, or in a "c:\subtitles" folder. The file needs to be named exactly the same as the original video file, minus any extension, such as



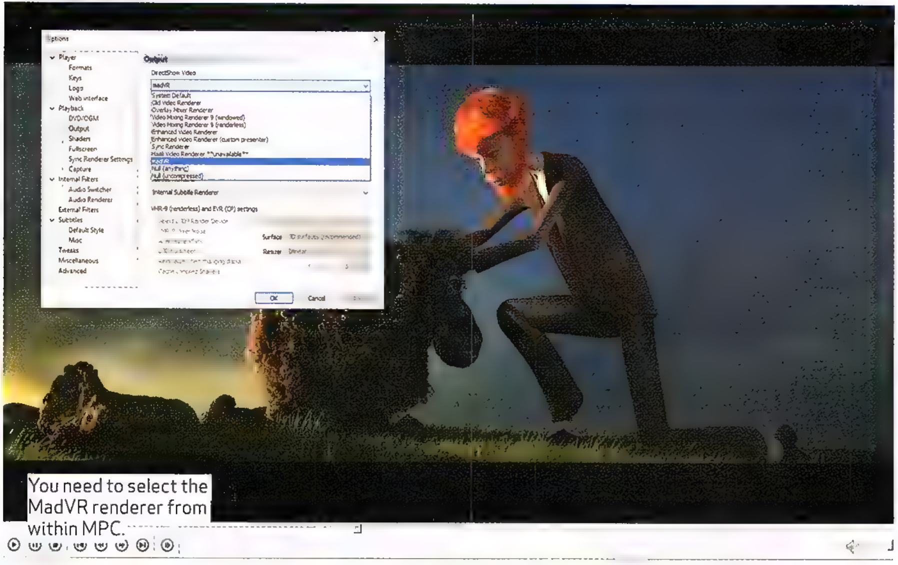
hdr

○ let madVR decide
○ passthrough HDR content to the display
● convert HDR content to SDR by using pixel shader math
○ convert HDR content to SDR by using an external 3DLUT
○ process HDR content by using pixel shader math
○ process HDR content by using an external 3DLUT

target peak nits: 200
tone mapping curve: BT.2390
gamut mapping algorithm: complex scientific mode - RGB clip
fix too bright & saturated pixels by: dynamic luminance & saturation reduction

☐ measure each frame's peak luminance (doesn't work with DXVA scaling / decoding)
☐ restore details in compressed highlights
activate anti-bloating filter strength: 100%
activate anti-ringing filter

Mad, you say? The number of options for settings is completely crazy.



You need to select the MadVR renderer from within MPC.

> "Typically, the display doesn't realise it's being fed HDR, but the PC can be equally clueless."

.mkv or .mp4. If you have issues with your vision, the placement and size settings can be very useful. For internal subtitles, use the MPC settings. Choose the required subtitles from "Play > Subtitles track." It has very similar controls under "View > Options > Subtitles settings."

SOUND

Getting the correct surround sound from a Windows system to an external amp or device can be frustrating. This is largely down to the number of non-obvious drivers, different settings at each stage, physical outputs, and compatibility issues with DRM and modern digital audio formats.

The first step is to check Windows is outputting audio to the correct device. Right-click the notification "Speaker" icon, and select "Playback devices." Windows lists all the audio devices it thinks it can send audio to. Built-in audio typically offers separate analog and digital output. Suitable HDMI digital devices are also listed, while there may be additional devices with audio output, too. If there's no sound to be heard, it's likely the wrong device is selected here. You can also configure the basic setup, and tell Windows whether this is a stereo or surround system. However, systems running Realtek audio might have the company's proprietary preference

Latest update

K-Lite Codec Pack 14.3.6 Update

An update is available with newer versions of MPC-HC, LAV Filters, and the Codec Tweak Tool.

News

AMD Radeon Driver 18.8.1

A new AMD graphics driver is available

Download - Release Notes - Reddit

K-Lite Codec Pack 14.3.6

A new version of the codec pack has been released

Download

Adobe Flash Player 30.0.0.134

A new version of the Flash browser plugin has been released

Download (Firefox/Opera/Safari)
Download (Internet Explorer)
Download (PPAPI)

Just get this...

Back in the day, we called it a "codec pack," an assortment of codecs bundled together so you could play pretty much any video you could throw at Windows Media Player.

It was like the Wild West, with all manner of codec combos springing up. Thankfully, things have become a little more enlightened and professional. If you want a simple answer to getting better video playback, we suggest you get the K-Lite Codec Pack Standard from **http://codecguide.com**. It's been around since 2003(ish), but recently underwent a modern dusting off.

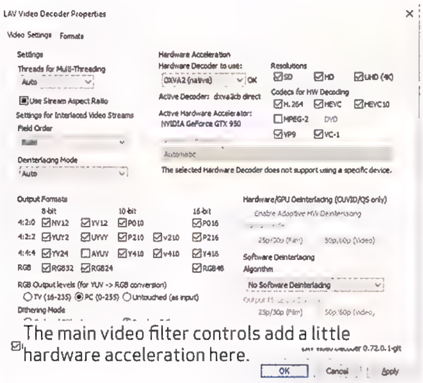
Inside the standard K-Lite pack, you'll find the cutting edge of open-source filter technologies: LAV video filter, LAV audio filter, and LAV splitter, alongside a number of other filters and tools. These first three handle all the various required filters to decode video and audio formats, plus container formats that hold them. You also get the widely used external subtitle filter, DirectVobSub, the popular Media Player Classic Home Cinema player, plus an external renderer, MadVR. There's a couple of useful tools for resetting settings and filter associations, too, in case things get messed up.

You can't install incompatible codecs/filters as such; DirectShow defaults to what it thinks is the best filter to use for the selected file type. What you can have are multiple codecs/filters installed that support the same format, and so are conflicting. For example, video-editing software installs its own codecs, but you might find these packs can cause issues or bizarre behavior.

system, where all this can be configured, too.

We're behind the times with audio, so we're still running a 5.1 surround system using stereo analog jacks – that's a jack per speaker pair, and one to handle both the sub and center speakers. The main reason is it forces decoding of any digital audio to the discrete surround channels. Otherwise, you need to pipe the raw digital signal down whatever digital connection you're using. The problem is, if your amp doesn't support that digital signal, you hear nothing, or the output device could fall back to stereo PCM audio, which won't make anyone happy.

As part of the K-Lite pack, LAV Audio is the main filter control for your audio. We'll look at using a digital audio device – think HDMI-connected device like a TV, or an AV amp via HDMI or optical – otherwise it's an analog connection. For digital movies, you'll want to enable bit-streaming – as long as your external device supports those formats – so the digital audio is streamed unmolested.



Threads for Multi-Threading: Auto

☒ Use Stream Aspect Ratio

Deinterlacing Mode: Auto

Hardware Decoder to use: DXVA2 (native) OK

Active Decoder: dxva2cb direct

Active Hardware Accelerator: NVIDIA GeForce GTX 950

Resolutions: ☑ SD ☑ HD ☑ UHD (4K)

Codecs for HW Decoding: ☑ H.264 ☑ HEVC ☑ HEVC10 ☐ MPEG-2 DVD ☑ VP9 ☑ VC-1

The selected Hardware Decoder does not support using a specific device.

	8-bit		10-bit		16-bit
4:2:0	☑ NV12	☑ YV12	☑ P010		☑ P016
4:2:2	☑ YUY2	☑ UYVY	☑ P210	☑ v210	☑ P216
4:4:4	☑ YV24	☐ AYUV	☑ Y410	☑ v410	☑ Y416
RGB	☑ RGB32	☑ RGB24			☑ RGB48

RGB Output levels (for YUV -> RGB conversion): ○ TV (16-235) ● PC (0-255) ○ Untouched (as input)

Software Deinterlacing Algorithm: No Software Deinterlacing

LAV Video Decoder 0.72.0.1-git

The main video filter controls add a little hardware acceleration here.

For analog targets, things aren't much more complex, but you'll want to specify the correct surround setup within the LAV Audio "Mixer" tab. Additionally, MPC has extended audio controls, if you need them, under "View > Options > Internal Filters > Audio Switcher." Normalisation helps boost quiet dialog; there's also a custom channel mixer, so you can specify what channel goes to which speaker. When it comes to playing video, if there are multiple audio tracks – such as director's commentary, English audio, or description audio – select alternatives using "Play > Audio track."

VIDEO

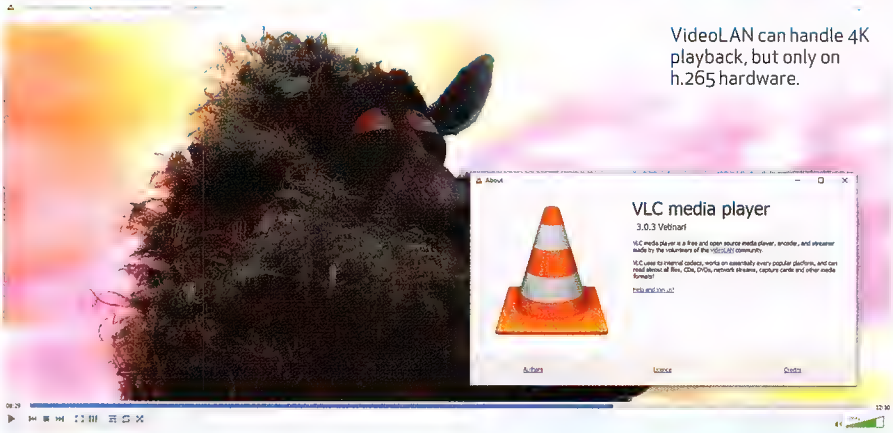
Subtitles are reading right, audio sounds super, now we can turn to the video. LAV Video is the decode filter that delivers support for all the major formats, along with hardware acceleration support for Intel Quick Sync, Nvidia CUVID, and DXVA2 native/copy-back. If you don't have a GPU, Intel Quick Sync is better than nothing, but it can cause quality issues on older processors; Nvidia CUVID is somewhat outdated; while DXVA2 is the favored option.

DXVA2 copy-back mode can enable higher quality video than native, as more filters can be applied, but it can increase the GPU load by three times. Native mode is faster, as the video data never leaves the GPU memory. You'll find the LAV Video settings tool in the K-Lite folder. Outside of hardware acceleration, you don't need to adjust anything, though we'd set "RGB Output Levels" to "PC (0 to 255)," otherwise you'll get pointless color space conversions.

We've largely been ignoring the need for a player, until now, but as we've come to actually playing video, it's worth hauling MPC into view. The open-source Media Player Classic has been the first choice of video player for years, but unfortunately, the 2017 release was the final one of the original maintainer. Thankfully, it seems some of the developers on **http://forum.doom9.org** are maintaining it with bug fixes.

MPC has loads of settings, but for video playback, we want "Options > Playback > Output" – the DirectShow Video pull-down enables you to select a renderer. The Enhanced Video Renderer (custom presenter) would do, but we're here to cover 4K HDR

> "For digital movies, you'll want to enable bit-streaming – as long as your external device supports those formats – so the digital audio is streamed unmolested."



VLC media player is a free and open source media player, encoder, and streamer made by the volunteers of the VideoLAN community.

VLC uses its internal codecs, works on essentially every popular platform, and can read almost all files, CDs, DVDs, network streams, capture cards and other media formats!

VideoLAN can handle 4K playback, but only on h.265 hardware.

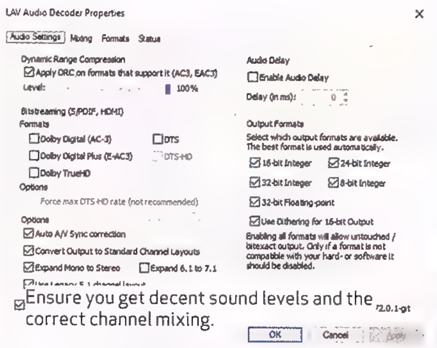
The wonder that is VideoLan

Worthy of its own section is the VideoLan Client (**www.videolan.org**), aka VLC – and turn the page for a deeper dive.

It's famous for its ability to play anything you throw at it, even if the file is corrupt or partially recovered. The reasons for its amazing abilities are many: Firstly, it's open source, so it has been openly developed, and is available for free to all; secondly, it uses its own built-in codec systems, and it supports pretty much everything. VLC is based in France, which enables it to ignore most USA-based software patents that would prevent other programs from including certain codecs.

Version 3.0, released at the start of 2018, introduced a host of innovations that brought VLC right up to date. These included default hardware decoding to support 4K and 8K playback, HDR 12-bit color, the ability to Chromecast, HD audio pass-through, VR video support, 8+ audio channel support, cross-platform hardware acceleration, AV1 codec, and Java Blu-ray menus, among many other changes.

Largely, VLC "just works™," which means you can simply download it, then let it get on with playing your content. Our main issue is that it's a little ugly; the preferences are borderline indecipherable, which isnot helped by its Linux roots, sometimes making options more complex. Another minus point is that it tends to not take advantage of GPU hardware as well as MPC does, so unless you have a processor that directly supports h.265 acceleration, it struggles to play 4K material.


LAV Audio Decoder Properties

Dynamic Range Compression
☑ Apply DRC on formats that support it (AC3, EAC3)
Level: 100%

Bitstreaming (S/PDIF, HDMI)
Formats
☐ Dolby Digital (AC-3) ☐ DTS
☐ Dolby Digital Plus (E-AC3) ☐ DTS-HD
☐ Dolby TrueHD
Options
Force max DTS-HD rate (not recommended)

Options
☑ Auto A/V Sync correction
☑ Convert Output to Standard Channel Layouts
☑ Expand Mono to Stereo ☐ Expand 6.1 to 7.1

Audio Delay
☐ Enable Audio Delay
Delay (in ms): 0

Output Formats
Select which output formats are available. The best format is used automatically.
☑ 16-bit Integer ☑ 24-bit Integer
☑ 32-bit Integer ☑ 8-bit Integer
☑ 32-bit Floating-point
☑ Use Dithering for 16-bit Output
Enabling all formats will allow untouched / bitexact output. Only if a format is not compatible with your hard- or software it should be disabled.

Ensure you get decent sound levels and the correct channel mixing.

playback, which throws up issues that standard PC players can't handle. The current solution is to use a renderer called MadVR, selected from here, but it has its own setting tool in the K-Lite folder.

HDR HEADACHES

What's the issue with HDR, then? If you're viewing HDR content from a PC, there can easily be a breakdown of communication between the display and the PC, even with an HDR setup. Typically, it's the display not realising it's being fed an HDR signal, but the PC can be equally clueless about having an HDR-capable display attached. The solution is to process the HDR video file as it's being displayed to a standard color range. This isn't a simple process – every frame has to be processed, and when you're dealing with a 4K resolution, that requires some serious CPU/GPU grunt, which is exactly what MadVR delivers, along with a bunch of other abilities.

MadVR's full name is Madshi Video Renderer, and it's registered as a DirectShow Renderer Filter. As mentioned, you select it within MPC and other compatible players as the renderer. You'll find a MadVR setting tool within the K-Lite app folder, and when a video is playing, a control icon appears in the notification area, with shortcuts to the settings.

The short answer on how to get correct HDR playback using MadVR is to pop into "Settings > Devices > [your display] > Identification." Select the correct device type – it'll get a pretty icon as a reward. "Properties" are probably correct, unless you have a display with 10-bit color depth; "RGB levels" should be 0 to 255, as always. Jump to "HDR," as the rest should be fine with defaults. You can stick with "Let MadVR decide," and it'll do its best to try to detect what your GPU and display are capable of. But if colors are really muted, you need to manually select the correct mode. If you have an HDR-capable display and GPU, selecting "Passthrough HDR content to the display" is your best choice, because it allows the display to do the processing, and is your only option for Dolby Vision content.

"Convert HDR content to SDR using pixel shader math" is the mostly likely option to choose if you don't have an HDR-capable display or GPU. You can largely leave the settings as you find them; there is an option to adjust the maximum "nits," but 200 is sensible, even if a display supports brighter.

The final option we'll consider is "Process HDR content by using pixel shader math." This is the option if you have an HDR-capable display and GPU, but want to let MadVR do the HDR processing, which would be an odd thing to do, frankly. We're going to skip over the two LUT-based options, as we're not going into creating a custom 3D look-up table for your display.

At this point, you'd be fine to enjoy 4K HDR playback even on modest hardware sporting a suitable GPU. If you're interested in the other options, most are for scaling, smoothing, and dithering. Largely, we'd recommend any DXVA2 as the fastest option. "Smooth Motion" under "Rendering" is one option that can help eliminate judder due to mismatched refresh rates – the default "Only if there would be motion judder" is the best to choose.

We're standing on the shoulders of the giant brains over at **http://forum.doom9.org**, so if you're at all interested in video quality, encoding, playback, and codec technology in general, check it out for years' worth of archived posts and help. ■

> "If you're viewing HDR content from a PC, there can easily be a breakdown of communication between the display and the PC, even with an HDR setup."

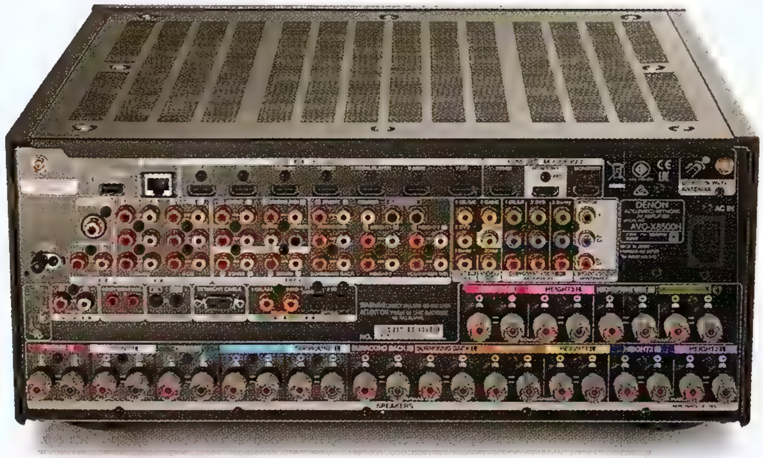
Home theaters

We're closet fans of home theater setups.

A quiet media center PC, powering a projector, and connected to a surround sound A/V amp makes for a formidable entertainment solution. For people from a PC background, though, the audio side of things can get neglected, but if you're entertaining the idea of a big screen, you're going to need a big soundscape to match.

We don't have space to explore all the options, but a good place to start is a suitable A/V amp with matching satellite surround speakers, plus a low-frequency effects subwoofer, if you're a fan of thumping bass. The latest marketing drive is Dolby Atmos, which adds vertical speakers to the mix, but even a basic 5/6/7.1 surround option is going to please your ears.

A potential issue for PC audio is the distinction between "generated" audio – from games, say – and pre-recorded DRM-protected audio, for a movie soundtrack. The later typically needs to be "passed through" to the A/V amp over a digital connection, else the DRM offers up the sound of silence. The flip issue when using a digital audio connection is that people only get stereo output for "normal" PC audio. The workaround is to use the audio jack's matrix output, and decode digital soundtracks to analog – yes, audiophiles, we went there.



Once you have a big screen, you'll want big sound to match, from something like this.

WHAT WERE THE BEST PC PRODUCTS OF 2018?

YOU TELL US!

Presented by *Future Publishing Australia*, for readers of *APC*, *TechLife*, *PC PowerPlay*, *TechRadar*, and *PC Gamer*, the *Australian PC Awards* recognises the best gear for PC and the companies behind the products.

It's up to you, our readers, to decide which products deserve to be called the best of the best.

Vote at www.australianpcawards.com.au

Voting is open between 7th February and 28th February. The winners will be announced at a special gala event on March 21st, and published online the next day.

By voting you could also win one of many fabulous prizes!

Best Motherboard Company
Best Premium Motherboard
Best Budget Motherboard
Best GPU Company
Best OEM Budget Card
Best OEM Performance Card
Best CPU Company
Best Value CPU
Best Performance CPU
Best HDD
Best SATA SSD
Best NVMe SSD
Best Home NAS
Best SOHO NAS
Best Value Laptop/2-in-1
Best Premium Laptop/2-in-1
Best Gaming Laptop
Best Desktop PC Builder
Best Memory Company
Best Cooling Product
Best Monitor
Best Keyboard
Best Mouse
Best Gaming Headphones
Best PC Case
Best Router
Best Reseller (online)
Best Reseller (retail)
Best Company

apc TECHlife PC PowerPlay

SUPPORTED BY

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FUTURE

Play all your media with VLC

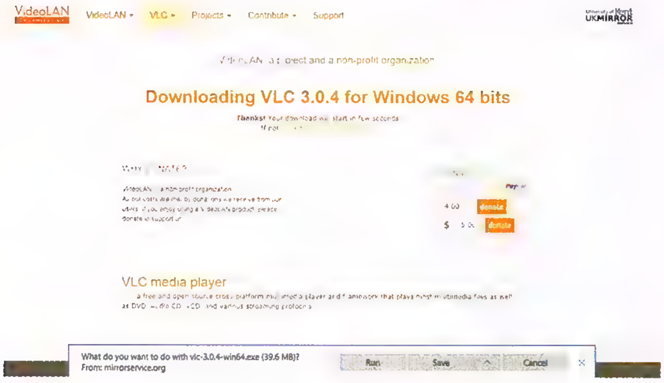
Enjoy films, music, Internet radio and every other type of media file with this inimitable – and free – app.

Have you ever tried to watch a DVD or Blu-ray movie on your PC? Then you'll know that Windows 10 no longer comes with a built-in optical disc player. Instead, you can play MP3 files via Windows' own Groove Music app, but it doesn't support podcasts or Internet radio. Likewise, the default Film & TV app can play some kinds of video files, but struggles with more exotic formats.

Enter VLC Media Player. It's a free and open source app, which can serve as a one-stop media centre. VLC not only supports DVD and Blu-ray playback but also a wealth of other codecs, meaning it can play virtually any media file. You can also use it to subscribe to podcasts and listen to Internet Radio. It is indeed one of the most popular and versatile PC apps and is held in high esteem.

In this guide, you'll discover some of VLC's basic features, as well as how to upgrade the default interface with a snazzy new skin. You'll also learn how to convert videos from one format to another, which is certainly useful for sharing files.

Get started with VLC media player



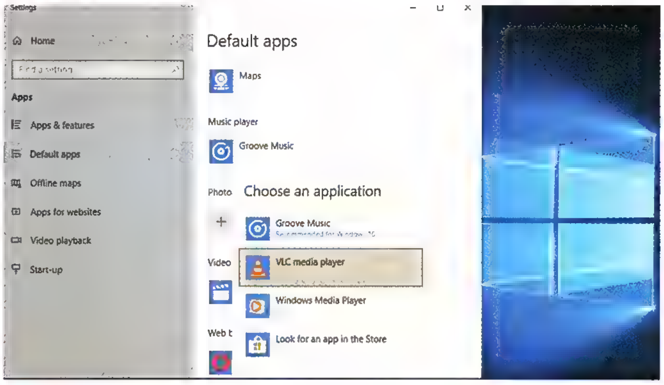
Downloading VLC 3.0.4 for Windows 64 bits

VLC media player

What do you want to do with vlc-3.0.4-win64.exe (39.6 MB)?
From: mirrorservice.org

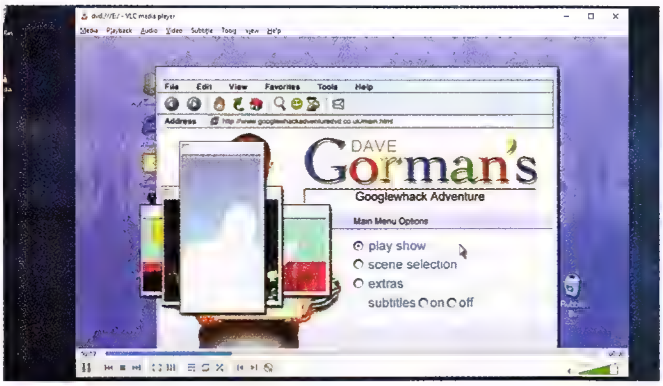
1 INSTALL VLC

Go to **www.videolan.org/vlc/index.html** and click Download, then Run to initiate. The Setup Wizard will walk you through installation. Choose your language and click OK. Click 'Next' on the license agreement. Next, confirm which components you wish to have installed, such as shortcuts for your desktop and Start menu. Confirm your program location. Click 'Install'.



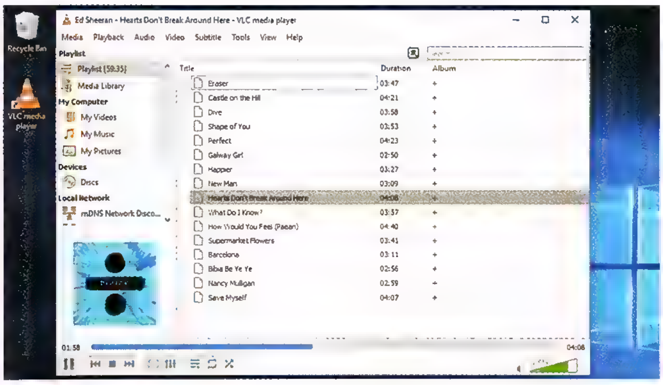
2 SET VLC AS DEFAULT MEDIA PLAYER

Open the Start menu and type default into the search bar. Choose 'Default app settings'. This will open a new window. Under 'Music player' click your audio player – for example, Groove Music. Under 'Choose an application', click 'VLC media player' to switch apps. Do the same for 'Video player'. If the change is successful the VLC Media Player icon will appear beside video and audio files.



3 PLAY DISCS

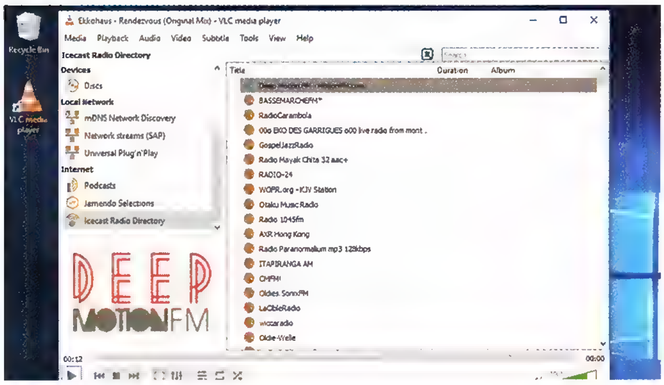
Launch VLC. Click 'Media'> Open Disc. Select the radio button next to your chosen format – DVD, for example. If you have more than one disc drive you can switch between these using the drop-down menu under Device, then click Play. Alternatively, insert a disc and click the Discs icon on the left of the screen. From here, double-click the disc drive to play a disc.



Title	Duration	Album
Eraser	03:47	+
Castle on the Hill	04:21	+
Dive	03:58	+
Shape of You	03:53	+
Perfect	04:23	+
Galway Girl	02:50	+
Happier	03:27	+
New Man	03:09	+
Hearts Don't Break Around Here	04:08	+
What Do I Know?	03:57	+
How Would You Feel (Paean)	04:40	+
Supermarket Flowers	03:41	+
Barcelona	03:11	+
Bibia Be Ye Ye	02:56	+
Nancy Mulligan	02:59	+
Save Myself	04:07	+

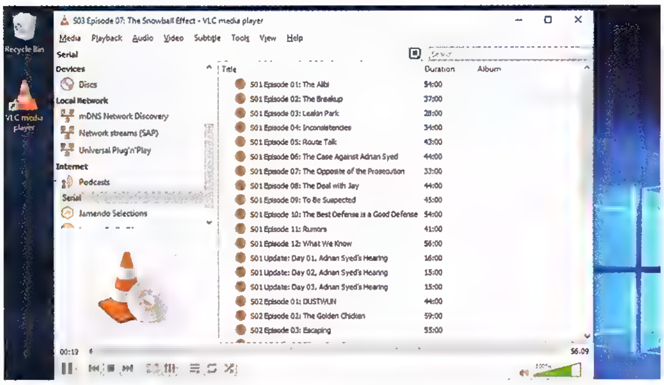
4 MANAGE PLAYLISTS

Choose your music files and drag them into VLC. Select 'Toggle Playlist' at the bottom of the screen to view them. Right-click a playlist to re-order the tracks or move them with your mouse. VLC will download the metadata for each file. These can be viewed on the bottom left of the window. Click 'Media' to 'Save Playlist to File'. This lets you open playlists in File Explorer.



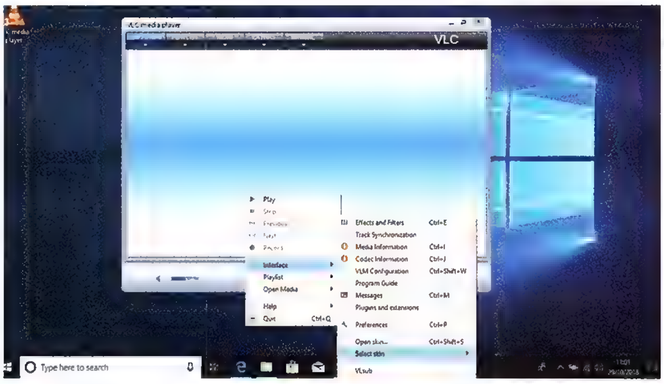
5 PLAY INTERNET RADIO

You can use VLC to listen to radio stations. To get started, move your mouse to the left-hand pane in VLC and scroll down to Internet. Choose 'Icecast Radio Directory'. Double-click on a listed station to start streaming. If your favourite station isn't listed, click Media > Open Network Stream. Paste the link to your station in the box marked 'Please enter a network URL', then click Play.



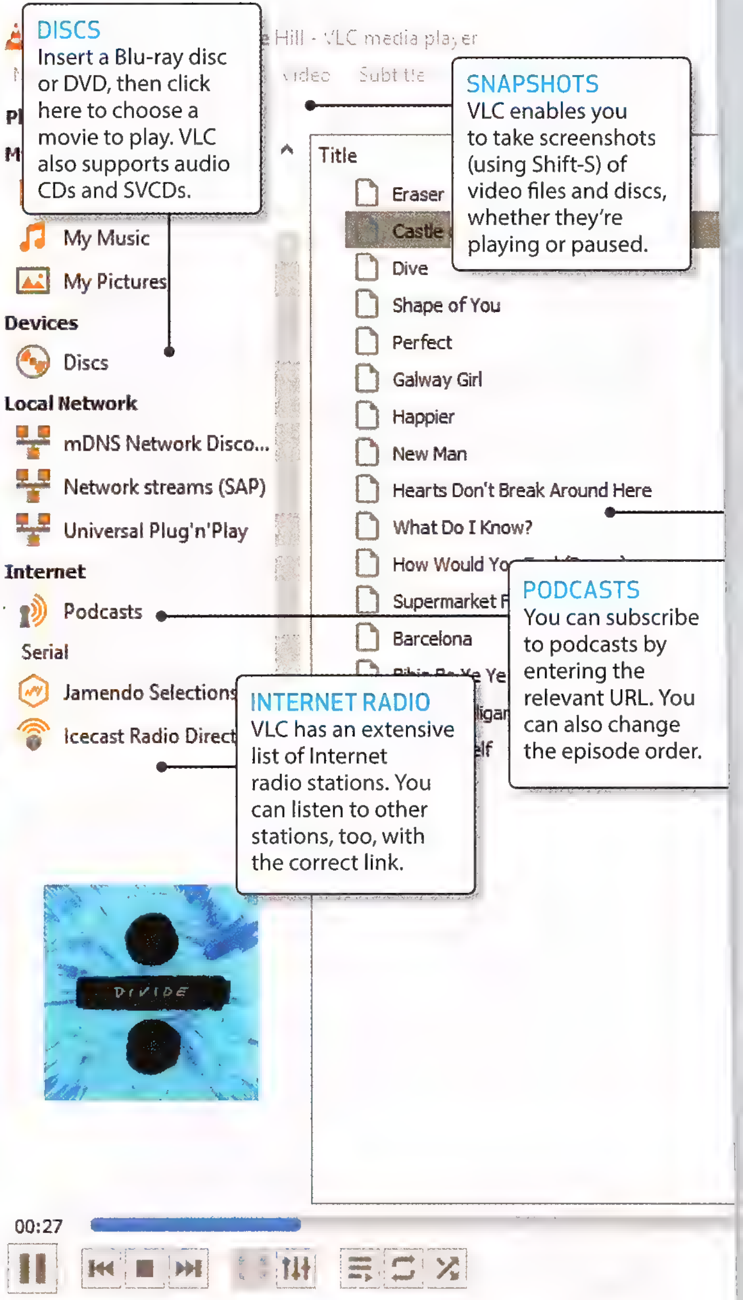
6 SUBSCRIBE TO PODCASTS

VLC also supports podcast subscriptions. Move your mouse to the left-hand pane and click the '+' button next to Internet > Podcasts. VLC will now ask you to enter the podcast subscription. Paste this into the link box and click OK. You can re-order podcast episodes in the same way as playlist tracks. Simply right-click on a list and choose to 'Sort by' title, URL, track, and so on.



7 INSTALL SKINS

Head to **www.videolan.org/vlc/skins.html**. Choose a theme and then select Downloads. In VLC, click Tools> Preferences. Under 'Interface', select Custom Skin. Click the Choose button and navigate to your downloaded skin. Click 'Save', then close VLC. Once you re-launch VLC, your chosen skin will load. Right-click anywhere on the screen to Open Skin or Select Skin.

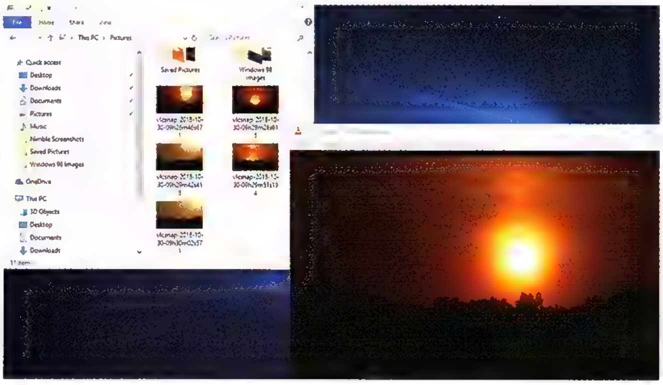


DISCS
Insert a Blu-ray disc or DVD, then click here to choose a movie to play. VLC also supports audio CDs and SVCDs.

SNAPSHOTS
VLC enables you to take screenshots (using Shift-S) of video files and discs, whether they're playing or paused.

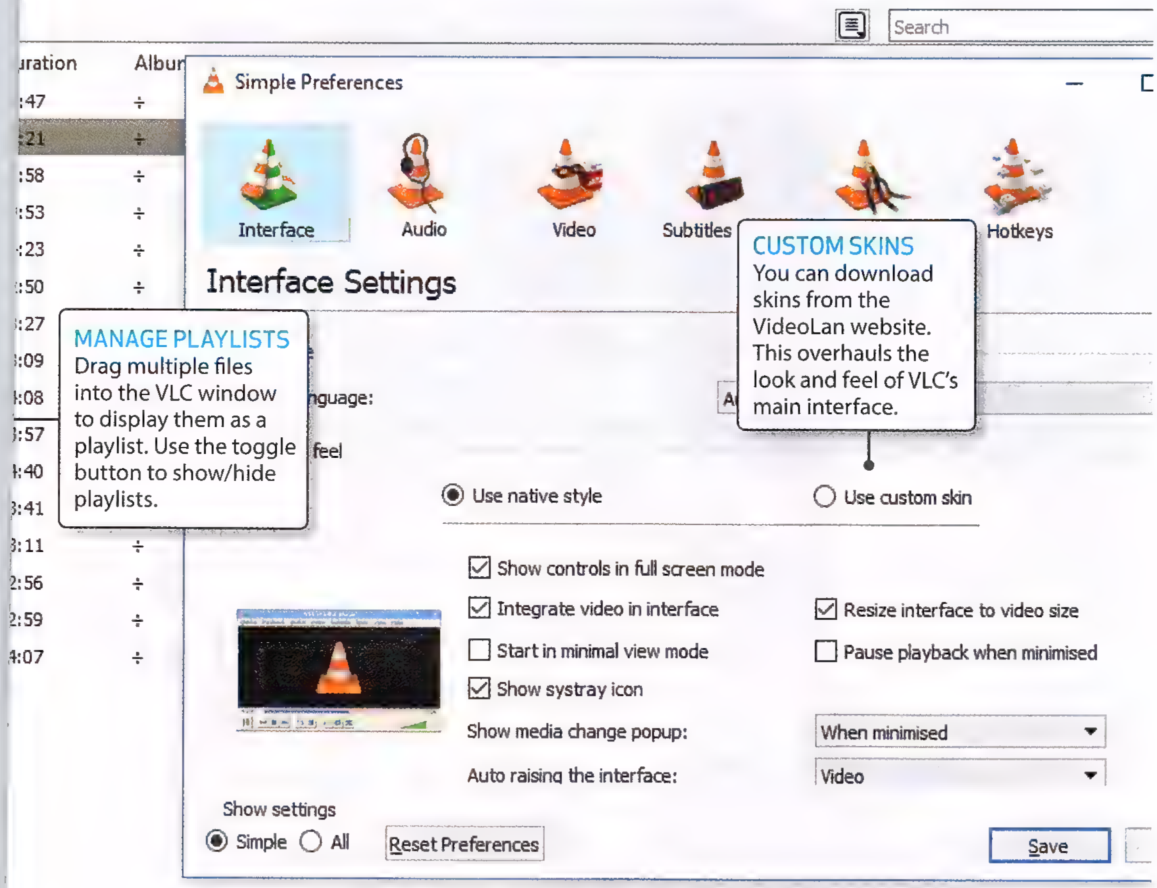
PODCASTS
You can subscribe to podcasts by entering the relevant URL. You can also change the episode order.

INTERNET RADIO
VLC has an extensive list of Internet radio stations. You can listen to other stations, too, with the correct link.



8 TAKE VIDEO SNAPSHOTS

VLC also gives you the ability to take screenshots of video files. Open your chosen video and pause it at the point where you want to take a still. Right-click to open VLC's context menu and then choose Video>'Take a snapshot'. (Alternatively, you can take a screenshot by using Shift-S]. Snapshots are saved to your Pictures folder in PNG format.



Interface Settings

● Use native style ○ Use custom skin

☑ Show controls in full screen mode

☑ Integrate video in interface ☑ Resize interface to video size

☐ Start in minimal view mode ☐ Pause playback when minimised

☑ Show systray icon

Show media change popup: When minimised

Auto raising the interface: Video

Show settings ● Simple ○ All

MANAGE PLAYLISTS
Drag multiple files into the VLC window to display them as a playlist. Use the toggle button to show/hide playlists.

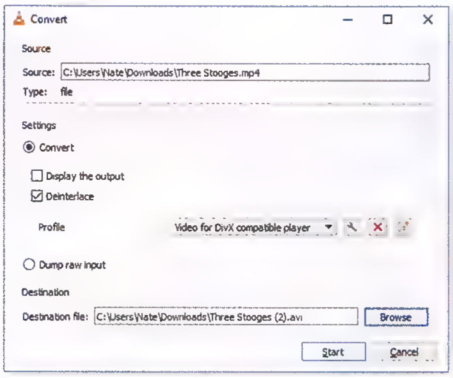
CUSTOM SKINS
You can download skins from the VideoLan website. This overhauls the look and feel of VLC's main interface.

Jargon buster!

SKINS
A downloadable file, which can change the look and feel of VLC. Certain skins may hide the menu or change the layout of buttons.

CODEC
Short for coder/decoder. Designed to encode various media files. VLC comes with a huge number of these, making it easy to play almost any type of audio or video.

SNAPSHOTS
VLC can take screenshots (stills) of videos it plays. By default these are saved automatically to your Pictures folder in PNG format.



Source

Source: C:\Users\Nate\Downloads\Three Stooges.mp4

Type: file

Settings

● Convert

☐ Display the output

☑ Deinterlace

Profile Video for DivX compatible player

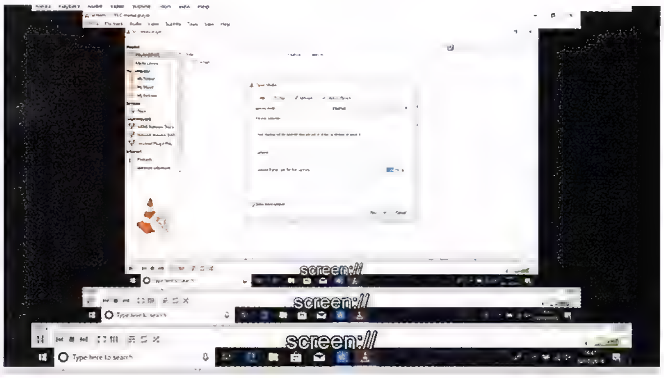
○ Dump raw input

Destination

Destination file: C:\Users\Nate\Downloads\Three Stooges (2).avi

9 CONVERT VIDEOS

Open 'Media'. Go to Convert/Save. Click 'Add'. Choose the file you want to convert. Next, click Profile. This is where you choose the converted video format – AVI, for example. Select 'Start'. If you only checked the Deinterlace box then conversion takes a matter of minutes. However, if you chose 'Display the output', conversion will take the same length of time as the video duration.



10 RECORD YOUR DESKTOP

VLC can record your desktop. First, open Media. Select 'Open Capture Device.' Switch 'Capture Mode' to Desktop. Next, choose the 'Desired frame rate for the capture'. Press 'Play' to start recording, and press the Stop button to end it. Right-click the video file in the Playlist section and choose to save. From here you can set a filename and video format for your recording. ■

NAS masterclass

Anthony Agius explains the basics behind what a NAS does, and the options you have for yours.

There comes a point in a nerd's life where squeezing in yet another internal hard drive or plugging in one more external hard drive becomes too much of a burden. Data spills out over multiple disks wasting precious storage, there's no protection against disk failures and sharing that data with other computers on your network is cumbersome.

This is why Network Attached Storage units (better known as a NAS) exist. These little boxes are essentially computers without monitors, designed to take a few hard drives and share the data on them across all the devices on your network. A NAS is usually powered up 24/7 so other devices can access the data without your desktop turned on or your laptop at home.

Because they're just headless computers that are always available, a NAS also makes the perfect home server. A small sample of the things a NAS can do besides basic file serving is serving up media around your home, being a central repository for surveillance cameras, a centralised backup destination for all your PCs and when you connect your NAS to the Internet, it can be your own personal cloud.

It might sound complicated, but a NAS can be simple to set up and once configured can be left alone to quietly sit in the corner and do its job with little fuss.

HARD DRIVE CHOICES

Most NAS units don't come with hard drives, so it's up to you to decide what size and style of drive you want to use. Seagate and Western Digital produce NAS specific hard drives designed to work happily in your NAS all day and all night. Seagate's are branded IronWolf and Western Digital assigns their NAS drives the colour Red.

These NAS drives are typically the same performance as a desktop drive but are tuned to last longer when operated permanently. A key specification is Mean Time Before Failure (MTBF). This is the how long the average hard drive should work before it craps out. MTBF on a desktop HDD is usually around 750,000 hours, but a NAS HDD will be built with heavy duty parts that enable an MTBF of 1 million hours or more.

NAS drives also have longer warranties, are designed to handle more vibration due to being in close proximity to other drives inside the NAS, superior power management so less electricity is used during 24/7 operation and firmware configured to ensure compatibility with various

Be sure to equip your NAS with a NAS-specific hard drive.

RAID array configurations.

Despite a NAS drive selling for a few more bucks than a desktop drive with the same capacity, these little tweaks make buying a Western Digital Red or a Seagate IronWolf a worthwhile purchase for your NAS setup. You should also consult the website of the NAS manufacturer and check its drive compatibility list to ensure the NAS you have in mind will work with the drives you want to install.

NETWORKING

The first step to get your NAS operational is to hook it up to your network. For most users, this is as simple as grabbing a network cable (sometimes the NAS manufacturer is kind enough to place one in the box) and plugging it in to the LAN portion of your modem/router. Be sure to use a Gigabit LAN port, as while a Fast Ethernet LAN port will work, it will be excruciatingly slow for file transfers between your computers and the NAS. If your network equipment lacks Gigabit, it's really time to upgrade!

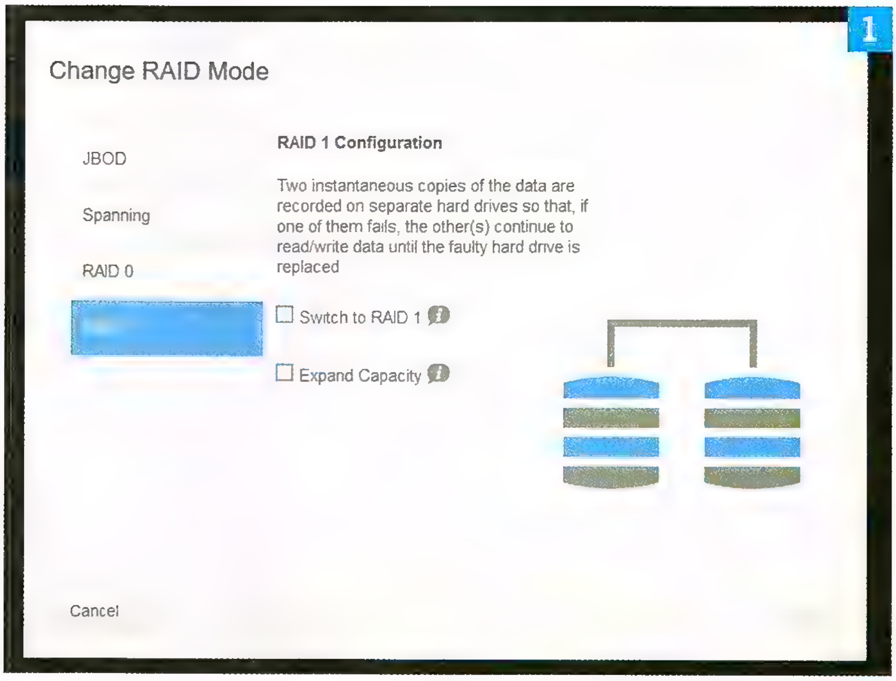
From here, the process varies from NAS to NAS as to how to connect to your new device. Consult the NAS manual for more information on how to find the NAS on your network, visit the NAS's configuration page and to log in to it. Most NAS units come with an application to install on your PC that detects the NAS on your network and loads up the web-based configuration portal.

RAID ARRAYS

One of the first questions you'll be asked when setting up your NAS is how to configure the hard drives. Most NAS units have more than one drive bay, which allows you to take advantage of a technology called RAID - Redundant Array of Inexpensive Disks. The basic premise of RAID is that a single copy of data is automatically copied across multiple disks (also known as an "array"), so if a disk decides to die data isn't lost.

Don't confuse RAID with a backup, as when you delete a file off a RAID array, that file is gone for good. RAID only protects you if a drive dies, not if you delete a file by accident, or an application wipes out your data. You need both RAID and backups to ensure your precious data doesn't vanish.

With that in mind, you'll need to decide on what flavour of RAID you want to configure on your NAS. For those with 2-bay units you've got two options: RAID-0 (aka stripe) or RAID-1 (mirror). RAID-0 has no redundancy but writes half a file to one drive and the other half to the other drive. When retrieving data, throughput is greater than a single disk due to using two disks at once. RAID-1 is true redundancy, with the full file copied to each disk, so if one breaks, data can be restored from the other disk. The side-effect of this is that the amount of available storage is half the installed capacity. For example, your NAS has two 4TB HDDs for a total of 8TB, but only 4TB is available for use as the other 4TB is used for the second copy of your data. [Image 1]



1

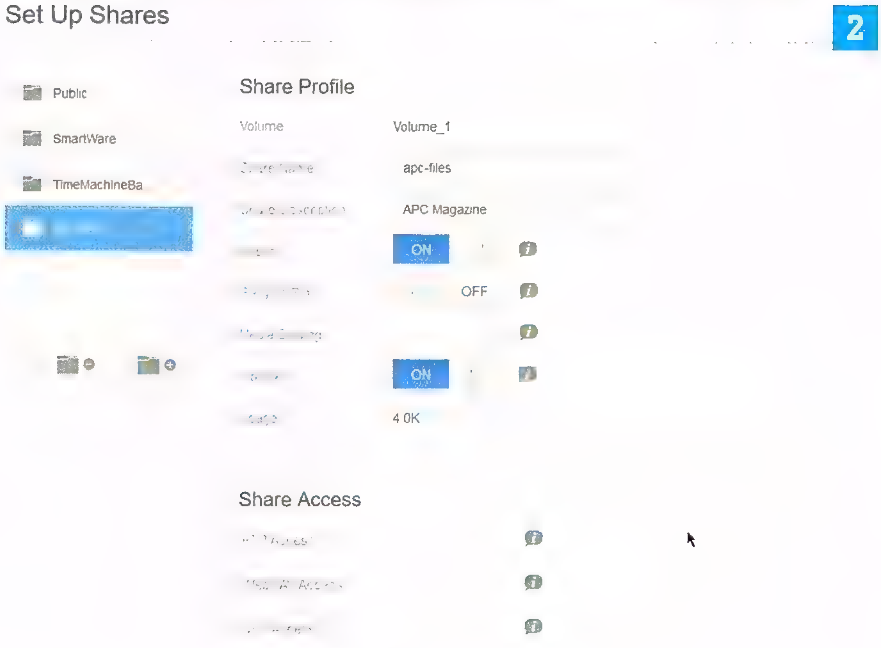
Change RAID Mode

RAID 1 Configuration

Two instantaneous copies of the data are recorded on separate hard drives so that, if one of them fails, the other(s) continue to read/write data until the faulty hard drive is replaced

☐ Switch to RAID 1

☐ Expand Capacity



2

Set Up Shares

Share Profile

Volume Volume_1

apc-files

APC Magazine

ON

OFF

ON

4 0K

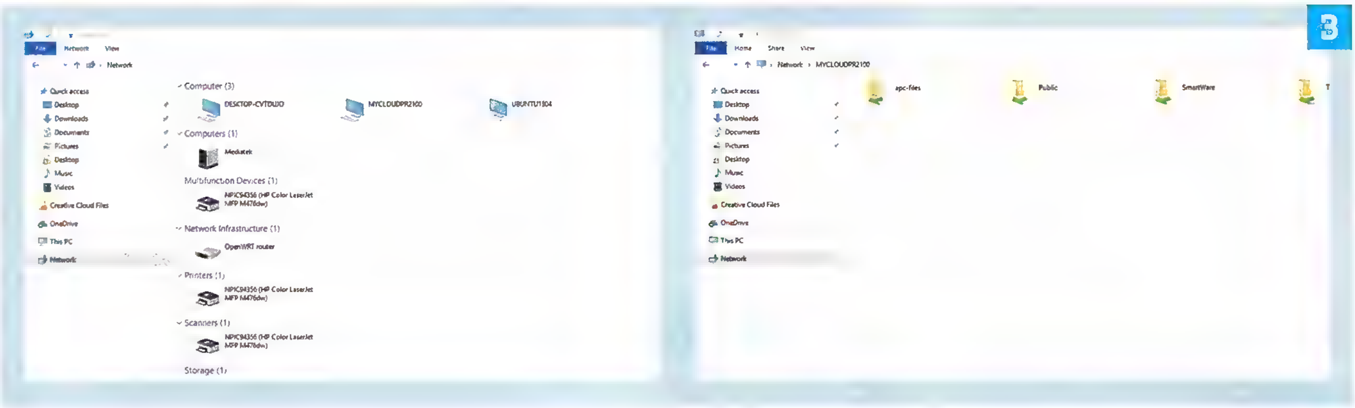
Share Access

Users with four disks or more in their NAS have other RAID levels to choose from. RAID-5 is a popular choice as it combines the speed benefits of RAID-0 with the redundancy of RAID-1. Instead of making a copy of a file to each drive, RAID-5 creates a second copy of the file and spreads it across each drive using a technique called "parity". If a drive in the array dies, the data can be reconstructed with the data on the other disks. For example, four 6TB drives in a RAID-5 will result in 18TB of usable capacity from the 24TB of raw storage.

A simple rule of thumb is for 2-bay units, go RAID-1 (mirror), for 4-bay units, go for RAID-5 (parity).

SHARING

Once you've plugged the NAS in and configured your storage, it's time to make it available to the rest of the devices on your network. Most NAS



units have a plethora of options available to view files. FTP, SFTP, WebDAV, NFS, SMB2, SMB3, AFP and more.

For the vast majority of people, SMB3 is the protocol of choice. It is compatible with Windows 8, Windows 10, macOS 10.10+ and most modern versions of Linux. For those running older operating systems (i.e: Windows 7), SMB2 can be used but is less secure as it lacks encryption and the performance enhancements of SMB3.

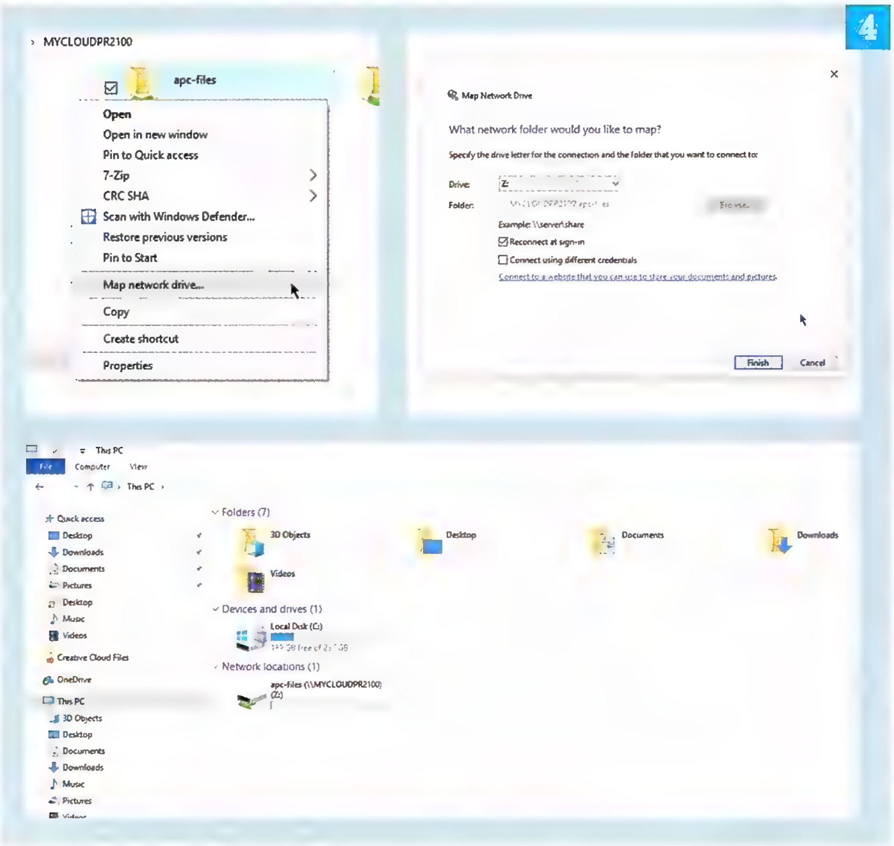
Mac users can enable AFP (Apple File Sharing) but Apple has depreciated AFP in modern releases of macOS and recommends the use of SMB3. Some users find SMB3 support on macOS a bit rough and enable NFS (UNIX Network File System).

How to actually create a shared folder on your NAS varies from manufacturer to manufacturer, but most have a web interface where you can configure and set up the unit. In there will be a file manager tool where you can create new directories and then configure that directory with sharing options. Consult the documentation that came with your NAS for specifics like setting user access controls (e.g: passwords) and storage quotas. [Image 2]

You can create as many folders as you like here and share them with different permissions or settings per folder. Many people have separate folders for music, movies, TV shows, personal data and so on.

After you've configured the shared folder, it's time to tell your PC that it exists. Accessing a file share on Windows is simply a matter of loading up Windows Explorer, go to "Network" in the sidebar and wait a few seconds for your NAS to appear in the list of devices. Double click the NAS and you should see the shared folder or folders you created. Double click that and you're ready to copy files across to your NAS. Just drag and drop or copy and paste the files you want to store on the NAS, like you would any other file on your computer. [Image 3]

You can "map" this shared folder to a disk drive letter (e.g: Z:\ or Y:\) which makes the shared folder appear to the computer as a regular old hard drive, but with the benefits of the NAS across a network! In Windows, simply right click the shared folder, select "Map Network Drive", select a drive letter and off you go. Do the same on other computers on your network you'd like to access the NAS. Now your files are available on all those computers at the same time. [Image 4]



What network folder would you like to map?

Specify the drive letter for the connection and the folder that you want to connect to:

Drive: Z:

Example: \\server\share

☑ Reconnect at sign-in

☐ Connect using different credentials

Connect to a website that you can use to store your documents and pictures.

APPLICATIONS

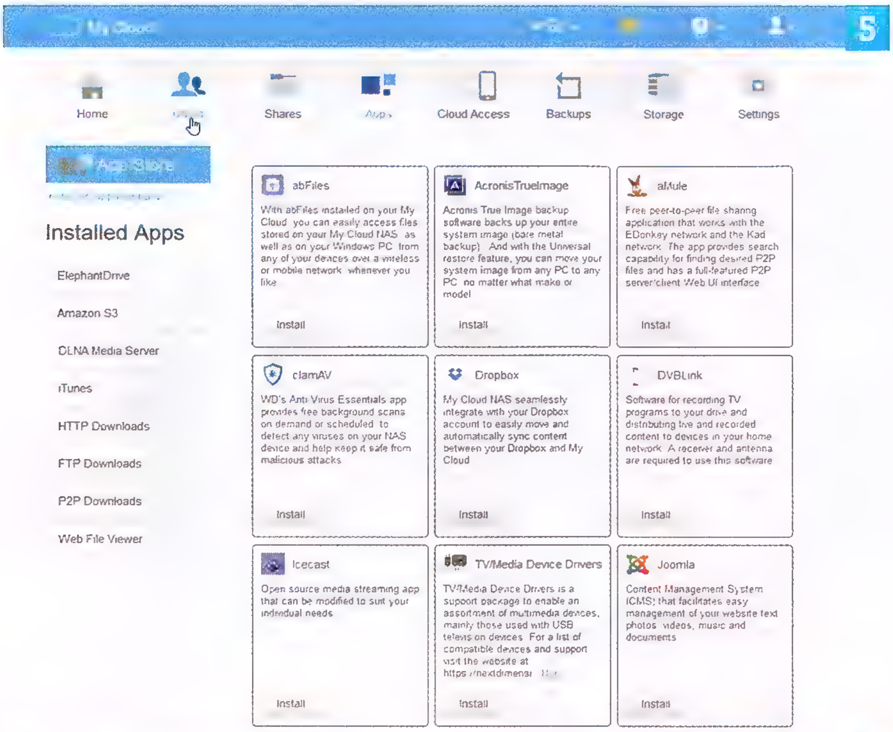
Now comes the fun part - using your NAS to serve up more than files. QNAP calls their app range "App Centre", Synology refers to them as "DSM Packages". Other NAS manufacturers have different names, but they're all apps, ether made by the NAS manufacturer or by 3rd parties. The vast majority are open source packages that have been bundled together in an easy to install package. [Image 5]

To make use of these apps, log in to the NAS management webpage and find the applications or packages option. In there you can search from hundreds of different applications that'll transform your NAS from a simple file server to a full-blown home server capable of many tasks.

HERE'S AN OVERVIEW OF SOME POPULAR APP PACKAGES:

PLEX

If you're an avid collector of TV shows and movies, Plex is a must have to organise your collection. It



abFiles

With abFiles installed on your My Cloud you can easily access files stored on your My Cloud NAS as well as on your Windows PC from any of your devices over a wireless or mobile network whenever you like

Install

AcronisTrueImage

Acronis True Image backup software backs up your entire system image (bare metal backup) And with the Universal restore feature, you can move your system image from any PC to any PC no matter what make or model

Install

aMule

Free peer-to-peer file sharing application that works with the EDonkey network and the Kad network The app provides search capability for finding desired P2P files and has a full-featured P2P server/client Web UI interface

Install

clamAV

WD's Anti Virus Essentials app provides free background scans on demand or scheduled to detect any viruses on your NAS device and help keep it safe from malicious attacks

Install

Dropbox

My Cloud NAS seamlessly integrate with your Dropbox account to easily move and automatically sync content between your Dropbox and My Cloud

Install

DVBLink

Software for recording TV programs to your drive and distributing live and recorded content to devices in your home network A receiver and antenna are required to use this software

Install

Icecast

Open source media streaming app that can be modified to suit your individual needs

Install

TV/Media Device Drivers

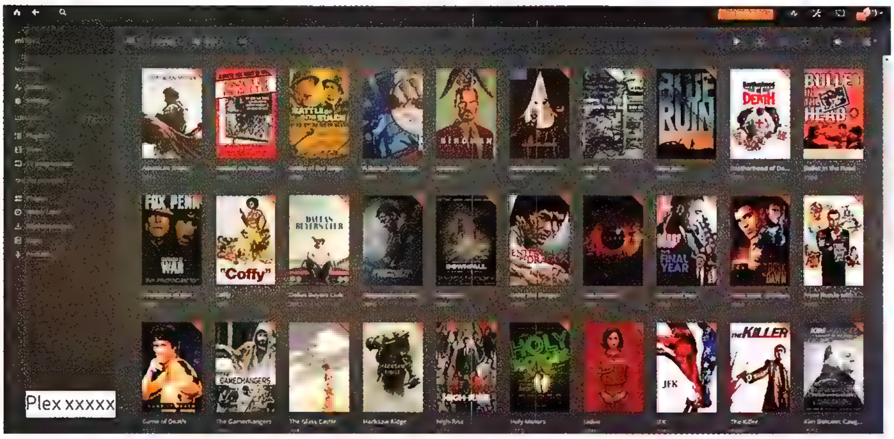
TV/Media Device Drivers is a support package to enable an assortment of multimedia devices, mainly those used with USB televis on devices For a list of compatible devices and support visit the website at https://nextdimensi

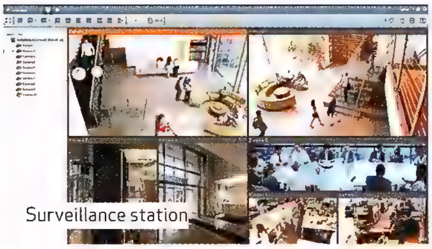
Install

Joomla

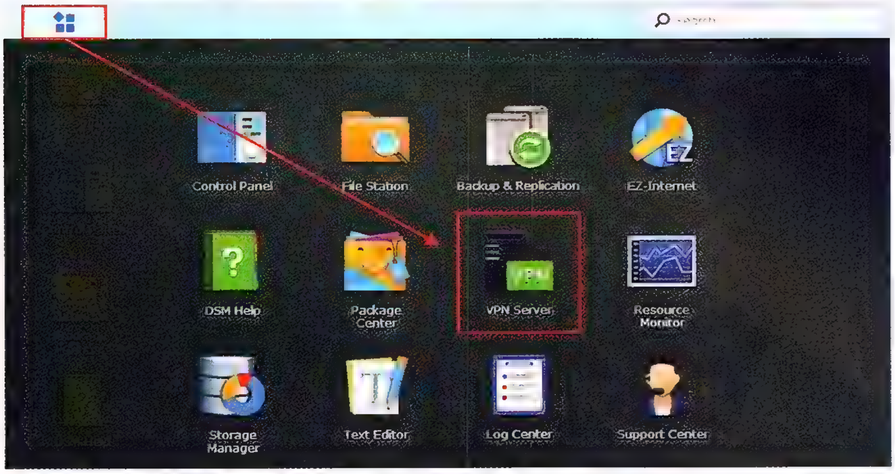
Content Management System (CMS) that facilitates easy management of your website text photos videos, music and documents

Install


Plex xxxxx


Surveillance station

Glacier



not only sorts everything out into neat categories, with synopsis and cover art, but also transcodes media on the fly so you can watch all your content, anywhere. There's dozens of client devices like smart TVs, smartphones, tablets, game consoles and more compatible with Plex, so you really can watch your media anywhere.

SURVEILLANCE STATION

IP-enabled security cameras have never been cheaper or easier to set up around your home. By utilising the surveillance station feature on your NAS, you can keep as much historical footage from as many cameras as you like without having to send the video to a cloud server and pay a hefty monthly fee. Use web or smartphone apps to view your cameras from anywhere in the world, straight from your NAS.

GLACIER

No backup is complete without adhering to the 3-2-1 rule. Three copies of the file, on two different mediums and one offsite. Use the Glacier feature on your NAS to back up your data to Amazon's Glacier cloud service and pay only a few dollars a month to store terabytes of data in their secure datacentre. If disaster strikes and all your backups have been nuked (e.g: flood or fire), you can pull data back off Glacier via the Internet for an extra cost.

PODCAST GENERATOR

Got a bunch of audio files you'd love to turn into a podcast, so you can listen to it in your podcast app of choice? Podcast Generator is the service you need. Point it to some MP3s or AAC files, pop them in the order you want them to appear and it will make an RSS feed just for you. Place that RSS feed into your favourite podcast app and away you go. Perfect for audiobooks you've ripped from CDs, old collections of radio shows and other content that's designed to be listened to in a certain order.

VPN SERVER

You're probably familiar with VPN services for protecting your privacy online, but their original purpose was to allow users to securely connect to a network remotely. By setting up the VPN server on your NAS, you can then connect to it from anywhere in the world and use your NAS and other devices on your network as if you were at home. The VPN servers available on most NAS units are compatible with Mac, Windows, iOS and Android with no extra software required. ■

HOT PRODUCT

STORAGE

$479 | **SYNOLOGY.COM**

Synology DiskStation DS218+

Synology's long tradition of first-rate NAS units continues.

On paper, the Synology DS218+ ticks all the boxes for a well-rounded 2-bay NAS. There's an Intel J3355 dual-core CPU, so it will run a wide range of apps. The default 2GB of RAM is enough for most people but can easily be expanded to 6GB with an additional SO-DIMM slot. Three USB ports make it easy to expand if you outgrow the internal 3.5-inch bays, as well as being useful to migrate data from your existing externals to your new NAS.

But that's pretty much the same story for all the NAS units in this review. What makes the DS218+ shine is Synology's DiskStation Manager (DSM) software. It's currently sitting at version 6.2 and the years of refinement show. Of all the NAS software here, DSM is the most polished and most capable. The inclusion of BTRFS (an advanced file system format) allows for features like snapshots and data integrity that other NAS units do not.

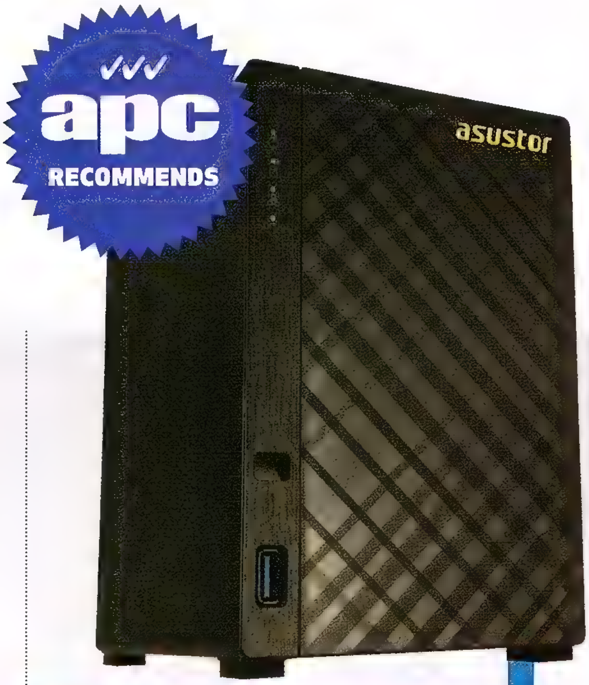
DSM's advantages continue with other features. Let's Encrypt support is built-in for industry standard SSL certificates that make external services (e.g: file sharing, calendars, etc.) more secure than self-signed certificates or no certificate at all. Synology Drive is an excellent Dropbox/Google Drive/OneDrive clone that is a class above the others.

Synology has perfected the NAS as a product, and it shows. The other NAS units here are not bad, not at all, but Synology's refinement and class across all its software offerings is clear. That makes the DS218+ the pick of the bunch. ■ Anthony Agius

Verdict

Synology is the market leader in the NAS game and it shows with the DS218+.

★★★★★



RECOMMENDS

STORAGE

$349 | **ASUSTOR.COM**

Asustor AS3102T v2

Cheap and full featured, just not as classy as the rest.

If the name Asustor sounds familiar, you're right – it's the storage arm of Asus. Its AS3102T v2 NAS unit is the cheapest of the four we have here and despite its low price, doesn't skimp on the specs. Intel dual-core CPU, 2GB of RAM, dual Gigabit Ethernet ports, HDMI output and three USB ports line it up with the rest of the units in our review.

That said, the AS3102T v2 skimps a little in regard to the drive bays (they require you to crack open the case and screw them in, unlike the others that have trays you slide in and out) and RAM being soldered on and non-expandable. Very minor details in the scheme of things, but differences none the less that explain the cost savings.

Where the wheat is separated from the chaff however, is software. Asustor Data Master (ADM) feels much like an older version of Synology's DSM, with most of the same features. The good news is that there's also heaps of apps available out of the box that are simple to use. Plex, Emby, Deluge and all manner of web hosting tools. If it's not available by default, you can also use Docker to install whatever you like.

A built in HDMI port allows the AS3102T v2 to be hooked up to a TV over and act like a media player where content plays directly off the device, instead of over the network. There's even a smartphone app to act as a remote for the unit. ■ Anthony Agius

Verdict

Even though the AS3102T is priced keenly, it lacks the polish of QNAP's & Synology's units.

★★★★☆

apc RECOMMENDS

STORAGE

$649 | WD.COM

WD MyCloud PR2100

Easy to buy, easy to configure, but lacks the feature depth of other.

WD is one of the few NAS manufacturers to include drives with its units; every other NAS in this round-up is BYO disks. The MyCloud Pro PR2100 comes in various capacities, from 4TB all the way up to 20TB. Being able to buy a NAS off the shelf, with drives pre-installed and ready to go is handy for time starved people. No worrying about drive compatibility issues!

The PR2100 has an Intel CPU (N3710 quad-core), dual Gigabit Ethernet ports and 4GB of RAM, making it one of the fastest units in this review. Interestingly, the PR2100 has dual power supply sockets, presumably to run two PSUs from different power sources for maximum uptime. It's odd to see that type of feature on a relatively non-enterprise unit like the PR2100.

Software wise, the MyCloud Pro range isn't exactly feature packed. While it does the basics right and is super easy to set up, it lacks the high-end features found on Synology and QNAP devices like Docker, snapshots, surveillance cameras, or the wide variety of pre-packaged apps that developers make for Synology & QNAP devices.

The PR2100's main feature is ease of use. Because there's just less stuff going on with MyCloud compared to DSM or QTS, it's much simpler to administer. Despite the ease of use, it's still got all the standard features you expect from a NAS, just not the more esoteric ones that some users may decide as "must haves" on their NAS shopping list. ■

Anthony Agius

Verdict

If quick and easy setup is your goal, the WD MyCloud range fits the bill.

★★★★☆

apc HOT PRODUCT

STORAGE

$489 | QNAP.COM

QNAP TS-251B

The inclusion of a PCIe slot at this price point spices things up.

QNAP's TS-251B packs an Intel J355 dual-core CPU, 2GB or 4GB of RAM expandable to 8GB, dual 3.5-inch HDD bays, one Gigabit Ethernet port and four USB 3.0 ports. Yep, sure sounds like a nice NAS, but where things get interesting with the TS-251B is the inclusion of a HDMI port and a PCIe slot. That's right, a PCIe slot, on a mid-range dual-bay NAS.

What can you use the slot for? QNAP sells a "QM2" card, which is an SSD coupled with a 10GbE network interface that really speeds things up. Or you could install a wireless network card if you're unable to place the TS-251B anywhere near your router.

QNAP rate the TS-251B's noise output at a meagre 17.3 db(A), making it the quietest unit in our round-up. In practice the difference between the other three is tiny. The drives you select will be more of a factor in the amount of disturbance to your peace and quiet a NAS will generate than its fan.

QTS – QNAP's embedded Linux operating system -- is top class and is almost as good as Synology's DSM. All the features you could ever want are here: cloud access, backup options galore, built-in media transcoding, smartphone apps and more. A massive range of 3rd party software too, like Plex, IFTTT and Docker.

It's tough to split QNAP and Synology's offerings as both are first rate and the decision boils down more to personal preference than any price or feature set. ■

Anthony Agius

Verdict

The inclusion of a PCIe slot for Wi-Fi or a super-fast SSD make this unit the upgrader's choice.

★★★★½

This aluminium case from Flirc has a built-in heatsink, which works wonderfully.

Build a Super Pi

Push your Raspberry Pi to the limit with this essential guide to enhancing and expanding the best tiny PC known to humanity.

The Raspberry Pi has transformed the way we look at computers and computing. Thanks to its ridiculously low cost of ownership, you can build a fully functional computer for under a tenner and put it to all kinds of uses. But sometimes that choice can be overwhelming – this is a computer that has gone into space for goodness sake – but that shouldn't stop you finding new ways to use it.

The Pi's versatility makes it the perfect tool for just about any task you could think for it to do. Looking for a replacement desktop for your PC? The Pi 3 has just about enough oomph – with the right support – to do that. How about using it as a portable device? A laptop maybe? Or at the very least as a portable touch-friendly unit? No problem.

In this feature, we explore how to build the ultimate Pi for use in a number of essential and common roles. We'll show you how to set it up as a desktop replacement or portable computer, capable of being powered by batteries. Then we'll reveal two great ways in which it can be put to more specific uses. First, as a media centre or server the Pi's low-power demands coupled with its new quad-core processor make it a great tool for serving your music, video and other media wherever you are in the home (or even further afield). But who needs a quad-core Pi when the Pi Zero can perform sterling service as an audiophile-friendly music player or full-blown streaming stick?

And last, but not least, the Internet of Things is all the rage, but there are so many gaps and shortcomings in existing ecosystems that the Pi is an almost obligatory addition to your IoT setup. We'll show you the key hardware considerations you need to follow, reveal a clever way of powering your Pi from up to 100 metres away and deliver you a software-building solution that will put you on the road to developing your own IoT applications. Enough preamble, let's get stuck in…

"The Pi's versatility makes it the perfect tool for just about any task you could think for it to do. Looking for a replacement desktop for your PC? The Pi 3 has just about enough oomph – with the right support – to do that."

The ultimate desktop Pi

Squeeze all the juice out of the Pi for a desktop PC.

The biggest advantage of using the Pi at the heart of a desktop-based system is its low cost. But if you want to eke every last drop of performance from it, what do you need to do? The first thing is – of course – to choose the latest Raspberry Pi 3 model as the heart of your desktop. It's head and shoulders above all other Pi models, and you can squeeze additional power from it through overclocking.

The desire to overclock moves us neatly on to the next phase: how can you keep your Pi from overheating? The solution lies in a heatsink. You can purchase these for as little as $2 each from the likes of Amazon but choose carefully: The 7.5mm sink will dissipate that bit more heat, but you won't be able to fit a HAT on top of it; if this is a deal-breaker, choose the 6mm model. If you want to push things even further, then check out ModMyPi's heatsink pack. It costs $8, plus pairs a 14mm-high sink for the CPU with a 10mm-high sink for the Ethernet controller. Again, these should fit into most standard cases on the market right now, but won't play nicely with any HATs.

An alternative solution is to look at the FLIRC case ($20, **www.pi-supply.com**). Its aluminium shell includes a built-in heatsink that basically protrudes from the shell to sit on top of the CPU and draw heat away from it. The end result is that your overclocked Pi 3 won't max out at more than 65 degrees Celsius, but again there's no room for any HATs.

One final recommendation is to shell out for the latest version of the official Raspberry Pi 3 power supply. It should supply 5.1V and 2.5A of power as opposed to the 5V/2A offered by older and unofficial models. Doing so will give you all the juice you need to push your Pi that bit further.

BOOT FROM USB

The Pi 3 has one other major advantage over earlier models: it supports USB booting. This means with a bit of work you can pair it with a USB flash or SSD hard drive to deliver a more responsive experience. Some users have reported success powering SSD drives from the Pi 3's USB port using a Y-splitter cable, but we found the drive was unstable and threw up errors when creating the root filesystem. If you fall into this category, you'll need to power the drive using its own dedicated supply.

If you're in the market for a suitable USB drive, the obvious choice is Western Digital's PiDrive range (**http://wdlabs.wd.com**) if you're after a larger hard drive, but SSD and flash drives will produce better performance. Despite the USB 2.0 bus, it appears USB 3.0 flash drives produce better results – the Sandisk Cruzer Ultra and Extreme 32GB and 64GB drives have been reported as both compatible and recommended due to their superior performance.

If you'd like your Pi to turn heads, then check out the box (A true desktop Pi, below) for details of an all-in-one chassis that includes a 720p HD display. Speaking of displays, the Pi 3 can output 4K on a suitable monitor, although you'll need to tweak the 'config.txt' file to add a suitable mode at 15Hz:

```
hdmi_cvt 3840 2160 15
```

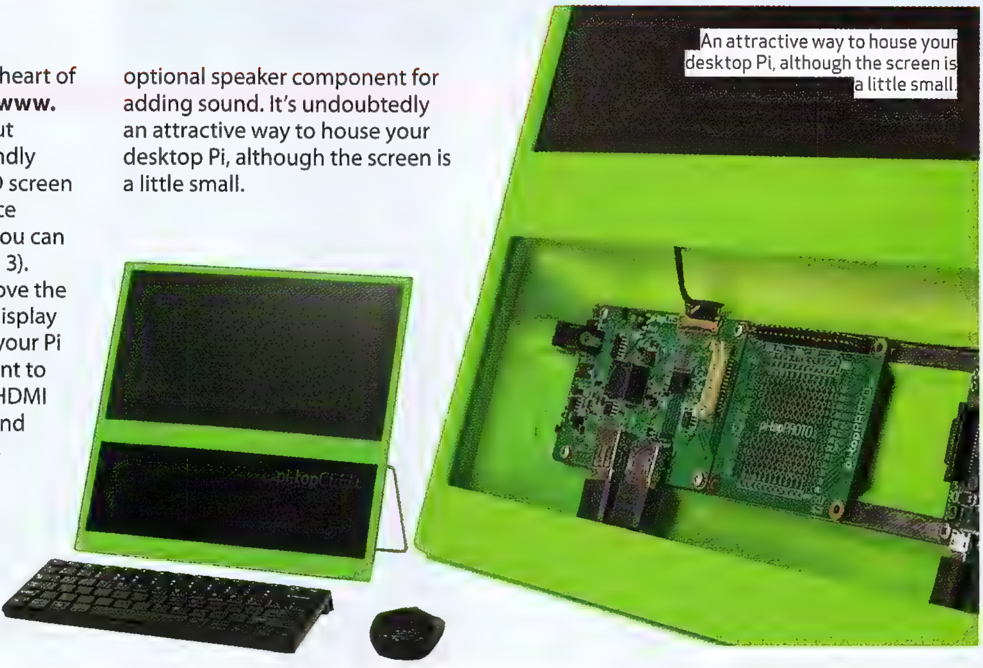
You may also want to consider a different distro to the regular Raspbian and Ubuntu Mate (**https://ubuntu-mate.org/raspberry-pi**) offers a slick alternative, but is a bit more demanding. We cover both over the page.

"Speaking of displays, the Pi 3 can output 4K on a suitable monitor."

A true desktop Pi

If you want your Pi to form the heart of an all-in-one device, then visit **www.pi-top.com** to learn more about the Pi-topCEED, a desktop-friendly chassis with built-in 14-inch HD screen (1,366x768 resolution) and space behind for your Raspberry Pi (you can purchase it with or without a Pi 3). Fitting is incredibly easy – remove the front panel from beneath the display to reveal a generous space for your Pi and any add-on boards you want to include. Hook up the Pi to the HDMI cable, place it on the mag rail and slide it to the end where it clips securely into place.

HATs and other add-ons are easy to install too – you'll need to purchase a pi-topPROTO accessory, which plugs into and slides into place on the mag rail. There's also an optional speaker component for adding sound. It's undoubtedly an attractive way to house your desktop Pi, although the screen is a little small.



An attractive way to house your desktop Pi, although the screen is a little small.

Boost performance

If you're going to use your Raspberry Pi as a desktop replacement, here's what you need to do.

You've purchased your kit and you're ready to build your ultimate desktop system. First things first: which distro will you choose? The obvious one is Raspbian, but if you're put off by its rather basic interface, then Ubuntu Mate should appeal. It scores points for providing a slicker, more desktop-like environment, but isn't as well supported and there's a performance price to pay for those bells and whistles, although you're less likely to feel the pain with the Pi 3. If Ubuntu Mate sounds like it could be your kind of thing, check out the box (Run Ubuntu from USB, below).

BOOT RASPBIAN FROM USB

Full instructions for preparing your Pi 3 for booting from USB 3.0 can be found at **www.raspberrypi.org/documentation** under Hardware > Raspberry Pi > BootModes > Mass Storage Device. Simply put, you'll first update your Pi's firmware with the experimental boot files, then enable USB boot mode. Reboot to test, then connect your USB drive and use parted to format it correctly with a 100MB FAT32 partition and Linux ext4 partition. You then create the boot and root filesystems, mount the new filesystems and copy your Raspbian system to it. Regenerate SSH host keys, edit the boot files to look for the USB drive, unmount your filesystems and then power off your Pi. Remove the SD card, reconnect the power and if all is well you'll be booting from your USB drive.

Sadly, the process isn't guaranteed to work with all drives – we were unable to get our Kingston SSDNow 64GB drive mounted in a StarTech chassis to boot directly as a result. We thought the problem might be down to the need for a longer delay at startup to allow the drive to be detected, so followed the work around at **www.raspberrypi.org/documentation/hardware/raspberrypi/bootmodes** which involves formatting a SD card (any size will do) in FAT32 and placing an updated bootcode.bin file on it along with an empty file you name timeout. With this in place, we were able to run Raspbian from the USB drive.

You may or may not notice an improvement in boot times, but you should quickly find your Pi is a little more responsive, which you can confirm by benchmarking the drive using `dd` and `hdparm`: and type the following:

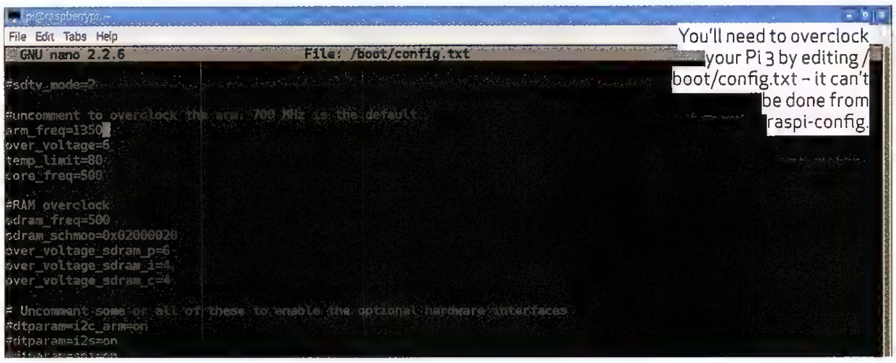
```
$ dd if=/dev/zero of=~/test.
tmp bs=500K count=1024
$ sudo hdparm -t /dev/sda
```

By using `dd`, we get the drive's sequential write speed by writing a 500KB file 1,024 times, while `hdparm` provides the drive's sequential read speed. We performed each test five times to get an average score – the SSD drive managed 30MB/s (write) and 33MB/s (read), compared to 8MB/s and 20MB/s for the SanDisk Ultra SD card. It's worth noting that these aren't true real-life tests – random read/write times will see a smaller gap between the two, but a fast USB drive will still be a step up from this, nonetheless.

OVERCLOCK YOUR PI

If you're looking to eke that bit more performance from your Pi, then obviously overclocking is the way to go. Sadly not all Pi 3's are equal, and you can't overclock using the official Raspbian configuration tool (or raspi-config for that matter), but don't let that stop you, because you can easily overclock it by editing the /boot/config.txt file.

There's actually three things you can overclock – the processor, obviously, but



```
GNU nano 2.2.6                    File: /boot/config.txt

#sdtv_mode=2

#uncomment to overclock the arm. 700 MHz is the default.
arm_freq=1350
over_voltage=6
temp_limit=80
core_freq=500

#RAM overclock
sdram_freq=500
sdram_schmoo=0x02000020
over_voltage_sdram_p=6
over_voltage_sdram_i=4
over_voltage_sdram_c=4

# Uncomment some or all of these to enable the optional hardware interfaces
#dtparam=i2c_arm=on
#dtparam=i2s=on
```

You'll need to overclock your Pi 3 by editing /boot/config.txt – it can't be done from raspi-config.

Run Ubuntu Mate from USB

If you want to run Ubuntu Mate from your USB drive, then you will need to follow a different procedure. The step-by-step guide (*see right*) reveals the prerequisites – you basically copy the Ubuntu Mate installer to your USB drive and copy the boot partition to a freshly formatted micro SD card for the initial installation.

All being well, you should be able to boot from your micro SD card, which then switches to the USB drive to complete the installation. Once you're logged in properly, open a Terminal window and type the following:

```
$ sudo fdisk /dev/sda
```

Type `p` and press Enter to make a note of where block sda2 starts (typically it's 133120). Now type `d` and hit Enter, then choose 2 to delete the second partition. Press `n` and hit Enter to create a new partition and type `p` for Primary partition followed by `2`. Now enter the figure you noted earlier (133120 in our case) and hit Enter, then hit Enter again to fill the remaining space. Finally, press `w` and hit Enter to make the changes. You'll see the warning, so `sudo reboot`.

Once rebooted, open another Terminal window and complete the resizing process with:

```
$ sudo resize2fs /dev/sda2
```

Once resized, verify the change via `df -h` and then use `sudo blkid` to identify the drive's UUID. Next, `sudo nano /etc/fstab` to edit the line from `/dev/mmcblk0p2` to `UUID=e440adac-fcf9-4b68-9f94-6bfd030f60b3` (or whatever your drive's UUID is). Save the file, reboot and you are finished. Note: You will still need to keep the micro SD inserted for Ubuntu Mate to boot, but it should be a bit more responsive, and you shouldn't have any problems booting even when other USB drives have been attached. We'd recommend that you visit **http://bit.ly/Pi2UbuntuMateSetup** as well for some other tweaks and tips to try out for optimising Mate.

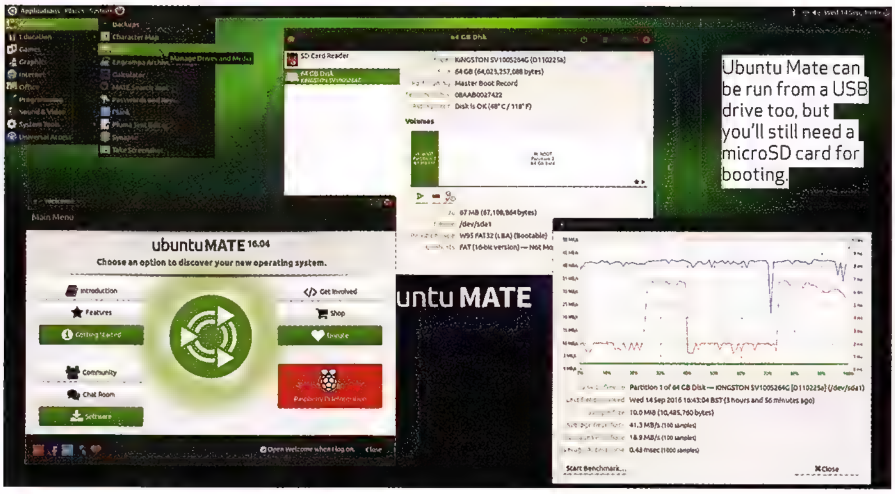
also your Pi's RAM and GPU too. A list of suggested settings for all these can be found at **https://github.com/retropie/retropie-setup/wiki/Overclocking**. We'd suggest sticking with the more modest 1.35GHz overclock and skip the GPU overclocking section (the gpu-mem setting refers to the amount of memory you allocate the graphics card – 128MB or even 64MB should be adequate for basic desktop use) unless you're looking to boost your gaming performance.

There are two things to consider: first how do you verify the overclock settings are in place? Use the following command to determine the minimum and maximum clock speeds:

```
$ lscpu | grep "MHz"
```

Second, how can you tell if your overclock is stable? Keep an eye on the CPU temperature by displaying it in the menu bar: right-click the menu bar and choose 'Add/Remove Panel Items'. Click 'Add' and select Temperature Monitor – you can then keep an eye on the temperature while you make use of your Pi. Anything under 80 degrees is fine, but hopefully your cooling system will ensure even when overclocked your CPU temperature remains under 60 degrees.

For a more in-depth look at overclocking, including some other tweaks you can apply (such as forcing your processor to always run in performance mode), check out Jackenhack's blog post at **www.jackenhack.com/raspberry-pi-3-overclocking**. There's a mention of running a custom Linpack script in the comments to stress-test your Pi, but we found it locked up our Pi even without overclocking, and there's a long discussion about what this means at **http://bit.ly/LinPackStressTest**.



Ubuntu Mate can be run from a USB drive too, but you'll still need a microSD card for booting.

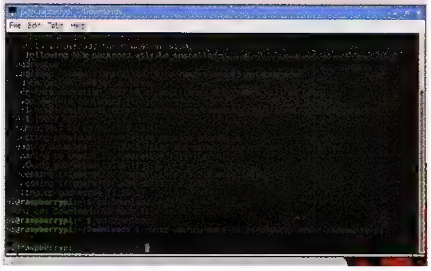
DESKTOP PERFORMANCE TIPS

Even with its quad-core processor, the Pi 3 isn't going to provide you with the same level of performance as even a modestly specified modern PC. One of the remaining bottlenecks is the 1GB of RAM, which is perfectly fine for one or two tasks, but you'll need to keep your aims realistic and avoid opening too many applications or browser tabs at once. Train yourself to keep things lean and mean, and you'll be able to enjoy perfectly adequate performance for basic desktop tasks such as web browsing (including cloud applications) and office work.

One final tip: both Epiphany (Raspbian) and Firefox (Ubuntu) browsers struggle to render certain websites, particularly those loaded up with JavaScript. The simplest solution is to switch browser to Chromium, particularly if you're planning to make use of Google services like Drive or Docs. Ubuntu Mate users can install Chromium through the Software Center, but it's not available through normal means to Raspbian Jessie users. No matter – just open a Terminal and enter the following:

```
$ wget -qO - http://bintray.com/user/downloadSubjectPublicKey?username=bintray | sudo apt-key add -
$ echo "deb http://dl.bintray.com/kusti8/chromium-rpi jessie main" | sudo tee -a /etc/apt/sources.list
$ sudo apt-get update
$ sudo apt-get install chromium-browser rpi-youtube -y
```

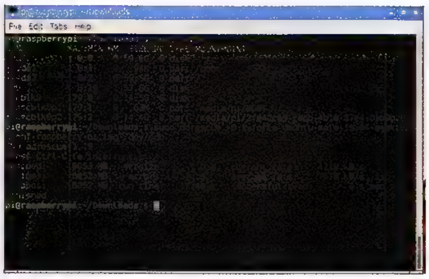
Install Ubuntu Mate to your USB drive



1 DOWN AND INSTALL

First you'll need to go to **https://ubuntu-mate.org**, click the 'Download' button and download the Raspberry Pi build to your internal storage. This will be in XZ compressed format, so open a Terminal and type the following:

```
$ sudo apt-get install gddrescue xz-uti && cd ~/Downloads
$ unxz ubuntu-mate-16.04-desktop-armhf-raspberry-pi.img.xz
```

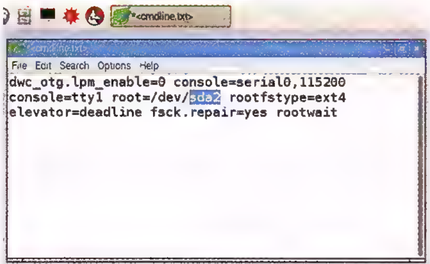


2 WRITE TO USB DRIVE

Insert your USB drive into your Raspberry Pi and unmount it if necessary. Now type `sudo lsblk` to identify it (for example, you'll see drives designated as **/dev/sdb** or **/dev/sdc**). Now type the following command, substituting the **/dev/sdc** designation in the example with the correct device name:

```
$ sudo ddrescue -D --force ubuntu-mate-15.10.3-desktop-armhf-raspberry-pi-2.img /dev/sdc
```

Wait while the image is written to the drive.



```
dwc_otg.lpm_enable=0 console=serial0,115200
console=tty1 root=/dev/sda2 rootfstype=ext4
elevator=deadline fsck.repair=yes rootwait
```

3 COPY THE ROOT PARTITION

Insert a spare micro SD card via a USB adaptor and format it using FAT32. Next, copy the contents of your USB drive's boot partition to the micro SD card. Now open the **cmdline.txt** file on the micro SD card and change the **/dev/mmcblkp2** reference to **/dev/sda2**. Save the file and exit. Plug the USB drive into your Raspberry Pi, insert the microSD card and connect the power to start installation.

The ultimate portable Pi

Discover how to take your Pi into the field and on the road.

The Pi's small-form factor and power demands make it the perfect candidate for use as a portable device and thanks to the range of cases, displays and battery power options out there, you can configure it just about any which way you choose. We've decided to build our ultimate portable Pi around the official 7-inch touchscreen, but see the box (below, Alternative Form-Factors) for that alternatives you might want to consider.

The official touchscreen costs around $120 from any reputable Pi outlet. You'll also need to purchase a suitable stand and case that you can attach your Pi. There are plenty of options here – we've plumped for the SmartiPi Touch case ($49, **www.robotgear.com.au**). The touchscreen fits snugly inside, secured by four screws, and there's a compartment on the back inside for your Pi, with all key ports left accessible (the micro SD card is the only exception, but thanks to the design of the clickable cover that holds it in place, it's easy enough to take out, flip over and swap out the card).

You can power the display one of two ways, the most convenient of which is via the 2-to-1 micro USB cable, which delivers power to both the Pi and the display from a single power cable. With this in mind, we recommend the newer 5.1V official power supply, particularly if you're planning to use HATs, which sit happily on top of the Pi's cover. (You can purchase an optional ribbon connector to extend them to the front of your Pi too.)

SMART SCREEN

The only drawback with the SmartPi is that the Pi's own HDMI port is hidden away out of reach, which makes it impossible to connect up a second display. All four USB ports and the Ethernet port are accessible, as is the 3.5mm audio jack for connecting to a speaker or headset. The case also comes with a LEGO-compatible camera case that clips neatly onto the front for video conferencing (and there's a handy slit in the compartment on the cover for slipping the camera cable through).

The case comes with an adjustable stand, which allows you to use it on any surface. More permanent fixtures – 75mm VESA mount holes, and two small metal screw mounts are included – are provided, but for portability you'll be wanting to use the stand.

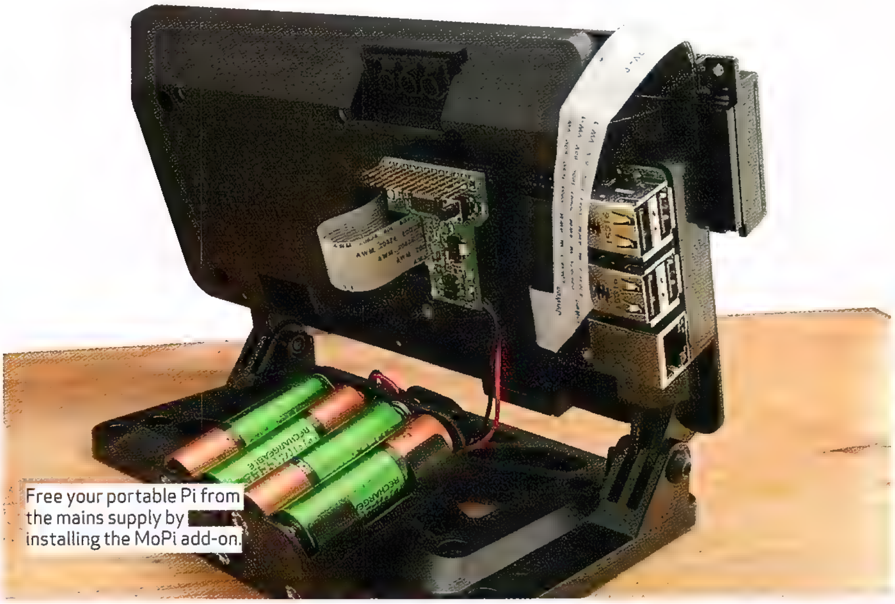
Construction is simple thanks to an online video – give yourself five to ten minutes and by the end your Pi will be snugly fitted along with the touchscreen, your camera mounted to the front and your HAT sitting snugly on top of the compartment cover. If you're worried about overheating, the cover includes a knock-out for a 6mm CPU heatsink.

We also recommend downloading the latest version of Raspbian Jessie from **www.raspberrypi.org** (click Downloads › Raspbian), and once installed bringing it fully up to date:

```
$ sudo apt-get update
$ sudo apt-get upgrade
```

You could bring the firmware up to date using `sudo rpi-update` if you wish, but it has no bearing on the performance of the touchscreen, although some users have reported that the Pi's CPU temperature drops by a couple of degrees through reduced load.

You can, of course, plug in a wired keyboard and mouse, but you might want to consider going down the



Free your portable Pi from the mains supply by installing the MoPi add-on.

Alternative form-factors

You don't need to build a portable Pi around the official 7-inch touchscreen. For example, if you've got $550 to spare you can purchase the Pi-Top, a full laptop chassis with keyboard, 13.3-inch HD screen (1,366x768) and smart battery offering up to ten hours of life.

Or you could go to the opposite extreme, and experiment with a 3.5-inch resistive touch-screen. There's a guide to building your own Nintendo DS-sized computer with 3.5-inch display and keyboard following Chris Robinson's guide at **https://youtu.be/NMkhRK2IV0E** – it'll cost you under $150, but you'll need to be a whizz with a hacksaw blade and glue gun as well as a soldering iron.

A simpler – and cheaper way – to add a 3.5-inch display to your Pi is through SB Components' LCD Control Case (from US$8, amazon.com), which comprises 320x240 resistive touchscreen with case, Wi-Fi dongle, tweaked Raspbian install (with LCD drivers) on 8GB microSD card and 3m long power supply. The main issue here is with the screen size – while it's technically possible to run the Raspbian desktop environment, you'll need to optimise it for the smaller screen.

There's space for around six desktop icons, for example, and you may find that it is more suited to Terminal use as well as mobile-friendly interfaces.

wireless route – most wireless keyboards, including Ebuyer's own Xenta-brand range, should work fine. To save space, choose one with a built-in touchpad. You can, of course, interact with the touchscreen itself, but it's handy to have an alternative.

If you find the backslash key is missing from your wireless keyboard, don't panic – you can get the backslash character by holding the Alt Gr key and hitting -, and then the | (pipe) symbol is obtained by holding Alt Gr as you hit the ` key in the top left-hand corner of the keyboard.

If you'd rather avoid using any form of wireless keyboard, you'll need to add an onscreen keyboard to Raspbian with:

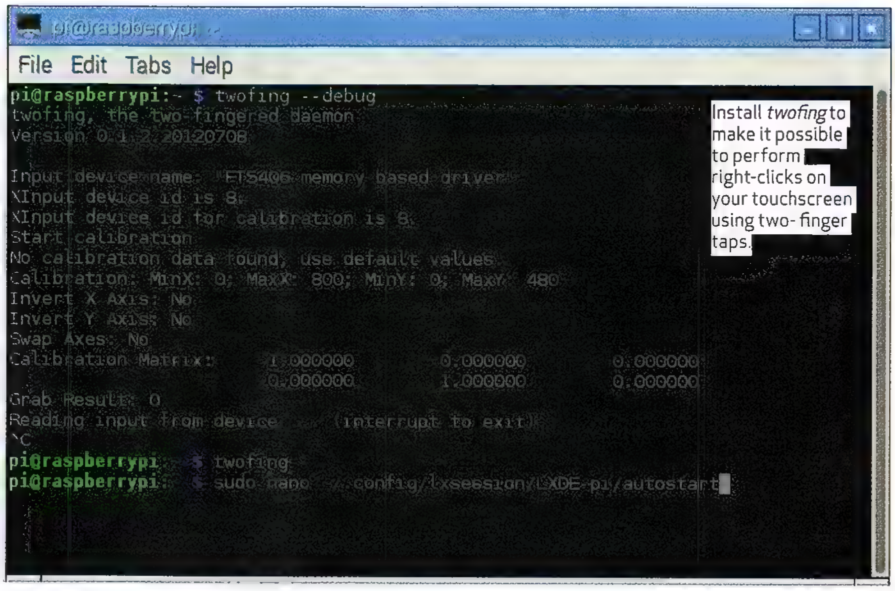
```
$ sudo apt-get install Florence
```

Once installed, *Florence* is run from the Universal Access menu. You'll see the onscreen keyboard appear, plus a small floating keyboard tile, which you tap to bring the virtual keyboard to and from the screen. Sadly, it doesn't work well with the Terminal, so keep a USB keyboard to hand.

Elsewhere, the touchscreen works well as a mouse substitute, but there's no right-click support and the recommended solution on the Raspberry Pi website only works with Wheezy and not Jessie. However, the box (*Add Right-Click To The Touchscreen, below*) reveals a workaround that simulates a right-click using two fingers.

PORTABLE POWER

As things stand, you have a compact, all-in-one solution for your Pi that's hamstrung by one critical problem: you need to be connected to mains power in order to use it. That's a problem that's easily fixed, and how you do this depends on your needs. The key consideration is that you supply a steady 5V of input from your battery, so you can't simply connect up four AA batteries and hope for the best (AA rechargeables would supply 4.8V in total, which would drop as the batteries discharged, while AA alkaline would supply 6V, which is outside the Pi's tolerance range).



```
pi@raspberrypi:~ $ twofing --debug
twofing, the two-fingered daemon
Version 0.1.2.20120708

Input device name: "FT5406 memory based driver"
XInput device id is 8.
XInput device id for calibration is 8.
Start calibration
No calibration data found, use default values.
Calibration: MinX: 0; MaxX: 800; MinY: 0; MaxY: 480
Invert X Axis: No
Invert Y Axis: No
Swap Axes: No
Calibration Matrix:     1.000000        0.000000        0.000000
                        0.000000        1.000000        0.000000
Grab Result: 0
Reading input from device ... (interrupt to exit)
^C
pi@raspberrypi:~ $ twofing
pi@raspberrypi:~ $ sudo nano ~/.config/lxsession/LXDE-pi/autostart
```

Install *twofing* to make it possible to perform right-clicks on your touchscreen using two-finger taps.

The simplest solution is to power your Pi using any kind of portable battery that's used to recharge smartphones. Make sure they have a 5V output setting and then all you need to do is plug one into your Pi to power it up. But what size battery should you go for? It all depends on your needs.

First, determine how much power (measured in milliamps per hour or mAh) you'll need to supply – not just the Pi (up to 1,200mAh), but also your touchscreen (around 500mAh) and any other devices (the camera requires 250mAh, for example). If you want to calculate the power draw of your USB devices, use the following command:

```
$ usb-devices | grep
'Product=\|MxPwr'
```

Tot up the figure and the result – 2,000mAh or upwards – is how much power you'll need for each hour of use. In theory this means a 10,000mAh battery will supply five hours of use, but in practice it's usually less because of the way they're manufactured, plus capacity reduces over their lifetime.

An alternative way to supply portable power to your Raspberry Pi is with the MoPi add-on ($44, **https://shop.pimoroni.com**). This plugs into your Pi's GPIO pins and allows you to connect a wide variety of batteries, from solar and car batteries to standard (and rechargeable) AA batteries, using standard screw terminals. There's also a handy on/off button and the MoPi will cleanly shut down your Pi when power drops below a certain level. You can even use it in conjunction with mains power, which turns it into UPS backup.

To keep things as portable as possible, we paired a MoPi with eight rechargeable AA batteries using a cheap AA battery holder. The MoPi supports input voltages from 6.2V up to 20V, so you'd need a minimum of six rechargeable 1.2V AA batteries, but we've gone for eight because you get longer battery life and it's one of the default supply profiles – all you need to do is remove the small jumper on the underside of the MoPi.

Just follow the step-by-step guide (**https://pi.gate.ac.uk/pages/mopi.html**) and you'll soon have your portable Pi running independently off mains power.

Add right-click to the touchscreen

On the whole, the touchscreen works well as a mouse substitute, but it lacks right-click support. The solution given on the Raspberry Pi website only works in Wheezy, but a better solution exists in the form of *twofing*, which allows you to generate a right-click by tapping the screen using two fingers.

First, go to **http://plippo.de/p/twofing** for the basic instructions on downloading and compiling the package. Before rebooting as instructed, however, you need to perform some additional steps.

First, create a **.rules** file:

```
$ sudo nano /etc/udev/
rules.d/70-touchscreen-
egalax.rules
```

Add the following line, then save and exit:

```
KERNEL=="event*",ATTRS{name
}=="FT5406 memory based driv
er",SYMLINK+="twofingtouch",R
UN+="/bin/chmod a+r /dev/
twofingtouch"
$ sudo cp twofing /usr/bin/
```

Reboot, then test it with the following:

```
$ twofing --debug
```

If successful, this should launch the calibration screen. Simply press Ctrl+c to exit, then type `twofing` and hit Enter to launch it. Close the Terminal window and experiment with tapping the screen with two fingers and you should see the right-click menu pop up. You can then add a line with `@/usr/bin/twofing` to **~/.config/lxsession/LXDE-pi/autostart** to have *twofing* run automatically in future.

The ultimate media Pi

Build a media centre, audio player or media server.

There's one thing the Pi is brilliant at and it's media. Whether you're looking for an audiophile-friendly music player, a simple set-top box for playing media through your TV or a full-blown media server for accessing your digital media from anywhere – there's a Pi capable of delivering what you want. In this portion of the feature, we're going to focus our efforts on creating a Pi media server, which will allow you to share all your video, music and photos with your other devices, both at home and further afield.

For the purposes of this project, we're focussing on the Raspberry Pi 3, largely because it delivers enough oomph to run a media server comfortably. But there are other benefits too – the Wi-Fi, in case you don't want to site it next to your router, and support for USB booting should you decide to dump the micro SD card in favour of an all-purpose drive both for running your server and storing your media on.

The big choice you need to make is which media server to run. Kodi's built-in media server will work, of course, but the experience isn't as rich on non-Kodi devices in terms of delivering artwork and metadata to help you identify what you're watching or listening to. We've successfully run Plex Media Server on both a Pi 2 and a Pi 3 for a number of years now. Check out **www.htpcguides.com** (go to Pi > Rasp Pi 2 and 3 > NAS and Media Server > Install Plex Media Server... for a suitable image and guide) if this appeals.

However, in the interests of flying the FOSS flag, we've plumped for Emby Media Server. It looks as good as Plex, but isn't as well tested on the Pi – however, the guide at **https://akosresch.wordpress.com/2016/05/11/installing-emby-server-on-raspberry-pi-3** provides you with the basic steps required to get the server up and running – you'll need to install imagemagick and the Mono library, and then it's a case of downloading and installing the Debian version of *Emby* Server.

Before launching Emby Server for the first time, we recommend doing the following, which will simplify issues accessing your media folders by making Emby run under your Pi user account: `$ sudo nano /etc/emby-server.conf`

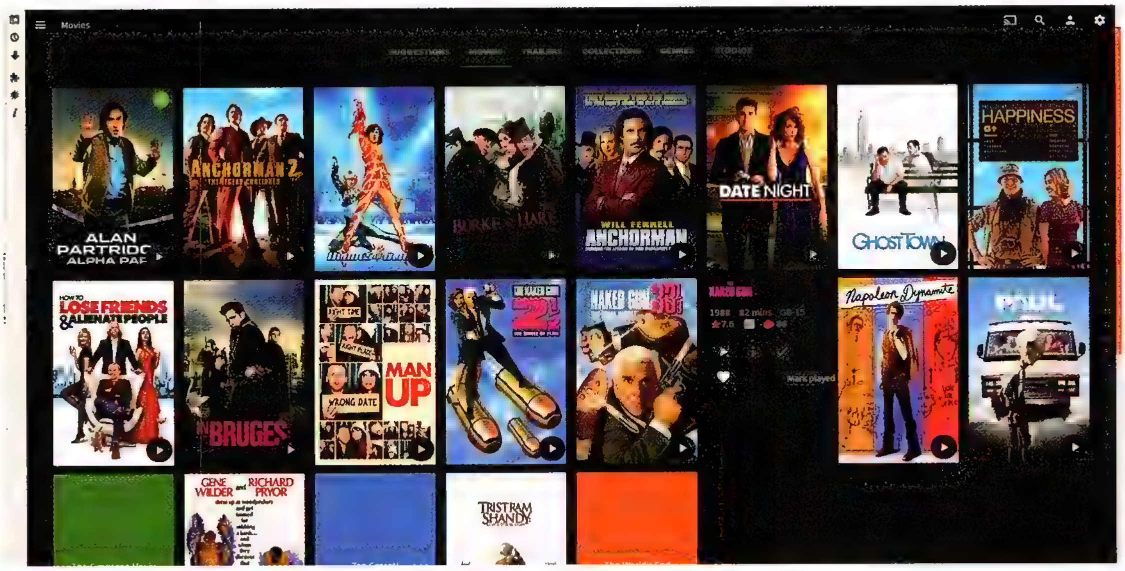
Add the following line to the end of the file before saving and closing:

```
EMBY_USER=pi
```

We'd also suggest you apply the FFmpeg fix (you'll need to `sudo apt-get install git` first). Once that lengthy process is complete, type the following to start up:

```
$ sudo service emby-server start
```

The server should now be up and running. Use the `ifconfig`



It'll take a little while, but eventually Emby will show off your media collection in all its glory.

Audiophile-friendly music

Imagine a pocket-sized audio player delivering superb quality digital sound through your home stereo or even a pair of recovered speakers. That's the thought behind Pi MusicBox, a software-based project.

We thought it best to pair the Pi Zero with the superlative Pi-DAC Zero (from $21, go to **www.iqaudio.co.uk** for more details) and the Pi MusicBox distro to deliver a headless audio player based on Mopidy, find the project at: **www.mopidy.com**.

Mopidy has moved on a long way since Pi MusicBox was last updated, so next issue we are going to show you how to build your own custom build based on the latest version of Mopidy, complete with full playlist support, your choice of front-end and support for a wide range of streaming services as well as locally stored music. While you wait for that, why not take the time to prep your Pi-based audio player? If you'd like to build a standalone audio receiver, then pair your Model A/B Pi with the Pi-DigiAMP+ ($97), power adapter ($38) and suitable case ($28). The Pi-DigiAMP+ delivers up to 35W stereo to a pair of two-wire speakers, which connect directly to its speaker terminals.

Build a Pi Zero streaming stick

If you want to build a Raspberry Pi-powered media centre you can tuck behind the TV, then pair a Pi Zero with the OSMC (**www.osmc.tv**) distro, which offers an optimised version of Kodi for lower-end machines. The initial setup would require you to have access to a wireless hub (we suggest the Broadcom Adaptor, which provides a two-port hub and Wi-Fi from a single plug. Get it for $20 from most reputable Pi stores, see **www.modmypi.com** for more details) to give you a great wireless connection and USB keyboard and/or mouse for the initial configuration that will take place.

Once this has been set up, you can remove the adaptor that you're using and replace it with a smaller Wi-Fi adaptor of your choice (we're particularly fond of the Pi Zero Wi-Fi micro USB dongle from ModMyPi at $14, for example. See the previous link for more details). While you can technically power your Pi Zero from your TV's own USB port, it's not usually reliable – instead, use its own dedicated supply. If you decide that you want to free up your keyboard for some other project, control OSMC using any Kodi-compatible mobile app, for example, we recommend that you try using the Kore app for Android.

command to determine your Pi's IP address, then switch to another computer and type the following into your web browser: **192.168.x.y:8096** (replace **192.168.x.y** with your Pi's IP address). If Emby has been set up correctly, you'll be shown the setup wizard. Going forward, this is also how you'll administer Emby – through a web browser.

NEXT STEPS

One of the biggest issues with Emby is gaining access to your stored media. Start by creating a mount point:

```
$ sudo mkdir /media/emby
```

If your media is stored on a NTFS-formatted USB drive, you need to first add the following:

```
$ sudo apt-get install ntfs-3g
```

Now plug the drive into your Pi and type `sudo blkid` to obtain the UUID of your mounted drive. Write this down, then type `sudo /etc/fstab` to have it automatically mount at startup. Add the following line if it's a FAT32 drive, replacing `<UUID>` with your drive's UUID:

```
UUID=<UUID> /media/emby vfat iocharset=utf8,rw,umask=000 0 0
```

If it's a NTFS drive, use the following for read/write access:

```
UUID=<UUID> /media/emby ntfs defaults,uid=1000,gid=100,dmask=027,fmask=137,utf8 0 0
```

You can also mount network drives too – so if your media is stored on a NAS drive, you can identify it using the smbclient tool (`sudo apt-get install smbclient` followed by `smbclient -L 192.168.x.y` , replacing the `192.168.x.y` with your network drive's actual IP address. Armed with this information, you can then populate the **fstab** file with something like this:

```
//192.168.x.y/<sharename> /mnt/<share1> cifs username=<username>,password=<passwd>,uid=1000,gid=100 0 0
```

Replace `192.168.x.y` with your network drive's IP address, `<sharename>` with the folder you wish to access, plus `<username>` and `<passwd>` with the username and password required to access the share in question. Save, exit and `umount -a` before `cd /media/emby` and `ls -l` to verify the drive has been mounted and that your user has the required permissions to read and write data to and from it (`drwxr-x---` on USB drives, `drwxr-xr-x` on network drives).

OSMC will happily run on a Pi Zero—and once you've performed the initial configuration it can run headless.

GET SET UP

With your media drive now visible, it's time to get up and running using the Emby setup wizard that is in your browser. While stepping through this, avoid any processor-intensive options like 'Enable chapter image extraction' when setting up any of your libraries. Also, if you're booting from a small (8-16GB) SD card, we recommend ticking 'Save artwork and metadata into media folders' to store all the data on your media drive.

You'll also be prompted to set up FFmpeg during the setup process – choose the 'system installed version' when prompted, then click 'Next'. From here it's all pretty straightforward and you'll soon find yourself at the Emby dashboard. Click the 'Home' button in the top left-hand corner to browse your media—at first, you'll see colourful squares representing movie and other media, but over time as Emby downloads metadata from the internet, they'll be replaced with proper artwork as well as information about the shows, movies or music in question.

This can take some time to complete – this is the Raspberry Pi after all – but you can immediately test your server by attempting to watch or listen to your library through the web browser. Click the 'Play' button next to a title and wait for it to start – again there's a short pause, but if all has been set up correctly, your media should play correctly, indicating it's now accessible.

From here you can explore the various ways of consuming Emby hosted media on many other devices and you can return to the Dashboard (click the menu in the top-left hand corner followed by 'Manage Server' to do so) in order to set up other libraries that you may need, manage multi-user access and perform other tasks. Check out our detailed guide to Emby media server for more help and advice – note that some of the tasks that are mentioned in the feature, such as setting up live TV support, are probably beyond the capabilities of your Pi. We also recommend restricting the Raspberry Pi's use to purely serving locally hosted media that's been saved in a universal format (MP4 container, H.264/MP3 codecs) to save the Pi the job of having to try and transcode the stream.

The ultimate IoT Pi

Build a cheap and effective IoT device using a Pi Zero.

We're still waiting for a single Internet of Things standard to emerge and chances are it never will. In the meantime, each time that you purchase a piece of IoT kit from one manufacturer, be it a motion sensor, security camera or smart lighting, you're gambling that it will not only work with your current ecosystem but that it will also prove flexible enough to work with others should the horse you've currently backed fall out of favour. And let us not talk about all of the different updates that break compatibility with older devices, eh SmartThings?

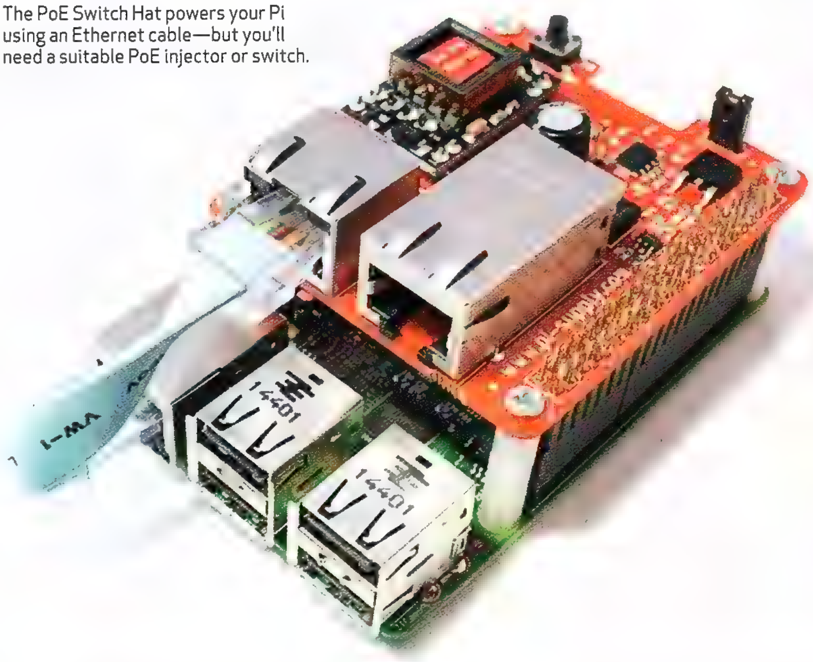
Services like **https://ifttt.com** go a long way to helping bridge the digital divide between devices, but why rely on a manufacturer's piece of expensive kit when you can custom-build your own versatile IoT gadgets using a Pi or Pi Zero? In this project, we're going to reveal the kit you need to build a core IoT device, then look at ways of adding to it and integrating it into various ecosystems.

BUILD YOUR BASE UNIT

The key consideration for your IoT device is which model of Pi you want to build it around. The Pi Zero is – on the surface – the obvious choice due to its small size and low cost of entry, although you need to factor in additional effort and cost: in particular, you'll need to be confident using a soldering iron to add on much-needed functionality, such as the GPIO pins and even an alternative power source as we'll see shortly.

At the other end of the scale, the Raspberry Pi 3 has the added advantages of built-in Wi-Fi and Bluetooth, and the extra processing power may be vital depending on how much functionality you want to pack into a single unit. It's also easier to add HATs including one that provides you with the means to power your Pi from its Ethernet port.

Next, consider your device's main



The PoE Switch Hat powers your Pi using an Ethernet cable—but you'll need a suitable PoE injector or switch.

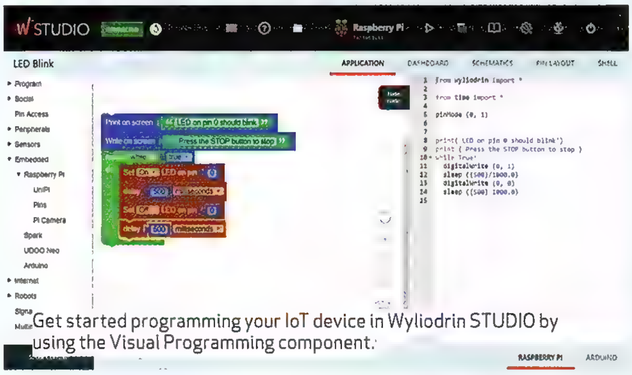
Build your own software projects

You've set up your hardware, but how do you go about integrating them into your IoT infrastructure? While extensively documented and supported, your hardware usually requires some Python programming skills to make use of its extensive libraries. If you're just starting out with programming, or want more flexibility, you should take a look at the open-source Wyliodrin IDE.

Wyliodrin is a web-based platform that tries to simplify the programming process by supporting a wide range of languages in a platform-agnostic way to let you put your projects together using a more user-friendly building-block approach called 'Visual Programming' while the code is written for you in the background.

First, you'll need to start by signing up for a free account at **www.wyliodrin.com**, then input the basic details of your Pi – its type and network connection (wired or wireless). Next, download the pre-built Raspbian image to a suitable microSD card – you can also add Wyliodrin to an existing installation via a lengthy script, but it takes hours to complete. Once done, embed a custom .JSON file that links your Raspberry Pi to your Wyliodrin account and reboot. As soon as you're logged in, your Pi should appear online in your Wyliodrin web console, ready for you to program.

From here the simplest approach is to install the Wyliodrin STUDIO Chromium extension. This extension supports JavaScript and Python, but it also gives you Visual Programming as an accessible way into coding, and the dashboard helps to visualise what you're actually doing. Of course, if you're already a programming whizz you can easily switch to code view if you prefer.



```
from wyliodrin import *

from time import *

pinMode (0, 1)


print('LED on pin 0 should blink')
print ('Press the STOP button to stop')
while True:
  digitalWrite (0, 1)
  sleep ((500)/1000.0)
  digitalWrite (0, 0)
  sleep ((500)/1000.0)
```

Get started programming your IoT device in Wyliodrin STUDIO by using the Visual Programming component.

purpose. If you want to use it as a camera, for example, then ask yourself whether you want a camera for daytime or night-time use – pick the Pi-NoIR model for the latter, paired with an infrared light source. If you plan to use the camera with your Pi Zero, don't forget to purchase the required cable. Also take the time to examine what cases are out there – two in particular caught our attention. The ZeroView ($13, **https://thepihut.com**) is a clever case and mount for the Pi Zero that attaches to glass surfaces, such as a window, and provides you with the means to monitor what's happening on the other side with minimal glare or reflection. Or look at the Pi Camera Box Bundle ($42, **www.modmypi.com**), which provides a case, wide-angle lens and wall mount for the Pi B+, 2 and 3.

Another potential use for your IoT device is as a sensor. The two obvious choices here are the Sense HAT ($72, from piaustralia.com.au) for the main Raspberry Pi, and the recently released Enviro pHAT ($22, **au.element14.com**), sized to match the Pi Zero and offering temperature/pressure, light level/colour, motion and analogue sensors (but you'll need to solder the supplied headers to it). If you're looking for a straightforward motion sensor, then the PIR Infrared Motion Sensor ($6, ModMyPi) is all you need – it's also built into the SPi-Box case, ready for pairing with your Pi camera.

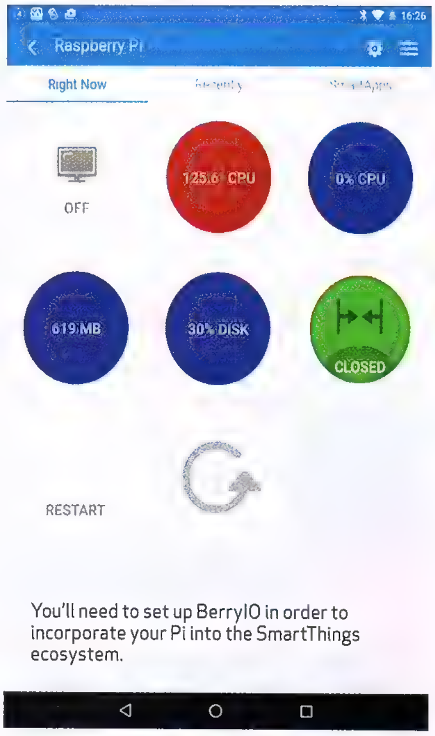
POWER YOUR DEVICE

A critical consideration for your IoT device is powering it. It's not always possible to find a convenient wall socket, so you may be tempted to go down the portable power route. The problem here is that you will need to recharge all of your batteries on a daily basis in most cases, so if your Pi is supposed to be left to its own devices 24-7 then it's not a practical solution.

One often overlooked solution is Power over Ethernet. Ethernet can be transmitted up to 100 metres, and the cables can carry both power and network, so you don't have to bother with a Wi-Fi adaptor or worry about weak or dead signals. A 100m cable can cost as little as $30, but spend a bit more and you can purchase cable rated for outdoor use – perfect if you've mounted your Pi at the other end of the garden in a waterproof location. However, there's one critical consideration before you begin: you'll need a switch or router that provides 802.3af PoE support, or purchase a special 802.3af PoE injector that sits between your switch/router and your Pi. A good injector is TP-Link's TL-POE150S ($25 **mwave.com.au**, which provides its own power supply and connects to any free port on your switch or router. You then plug the other end into the PoE switch on your Pi, which can then consume up to 13W of power.

If you plan to power multiple devices then a full-blown PoE-compatible switch may seem attractive, given that you often get up to four ports offering PoE connections. But check the total power budget before you begin – TRENDnet's TPE-S44 switch costs under $130 and offers eight 10/100Mbps ports in total (four of which support PoE), but it can only supply a total 30W across those ports, for example. That should be sufficient for low-powered headless devices, but doesn't give you much room for manoeuvre.

If this means of power appeals, then the PoE Switch Hat ($55, **au.element14.com**) will work with the Pi B+ or later – it features a handy programmable power switch too. A Model B-compatible switch can be purchased for around $100.



You'll need to set up BerryIO in order to incorporate your Pi into the SmartThings ecosystem.

> "Why rely on a manufacturer's piece of expensive kit when you can custom-build your own?"

If you want to use PoE with the Pi Zero then you'll need to go down the DIY route. One project in active development is the PoEPi: Pi Zero project, which has the added benefit of also providing your Pi Zero with an Ethernet port. It's shaped to sit neatly on top of the Pi Zero board, but it's still early days. You can follow its progress at **https://hackaday.io/project/9455**.

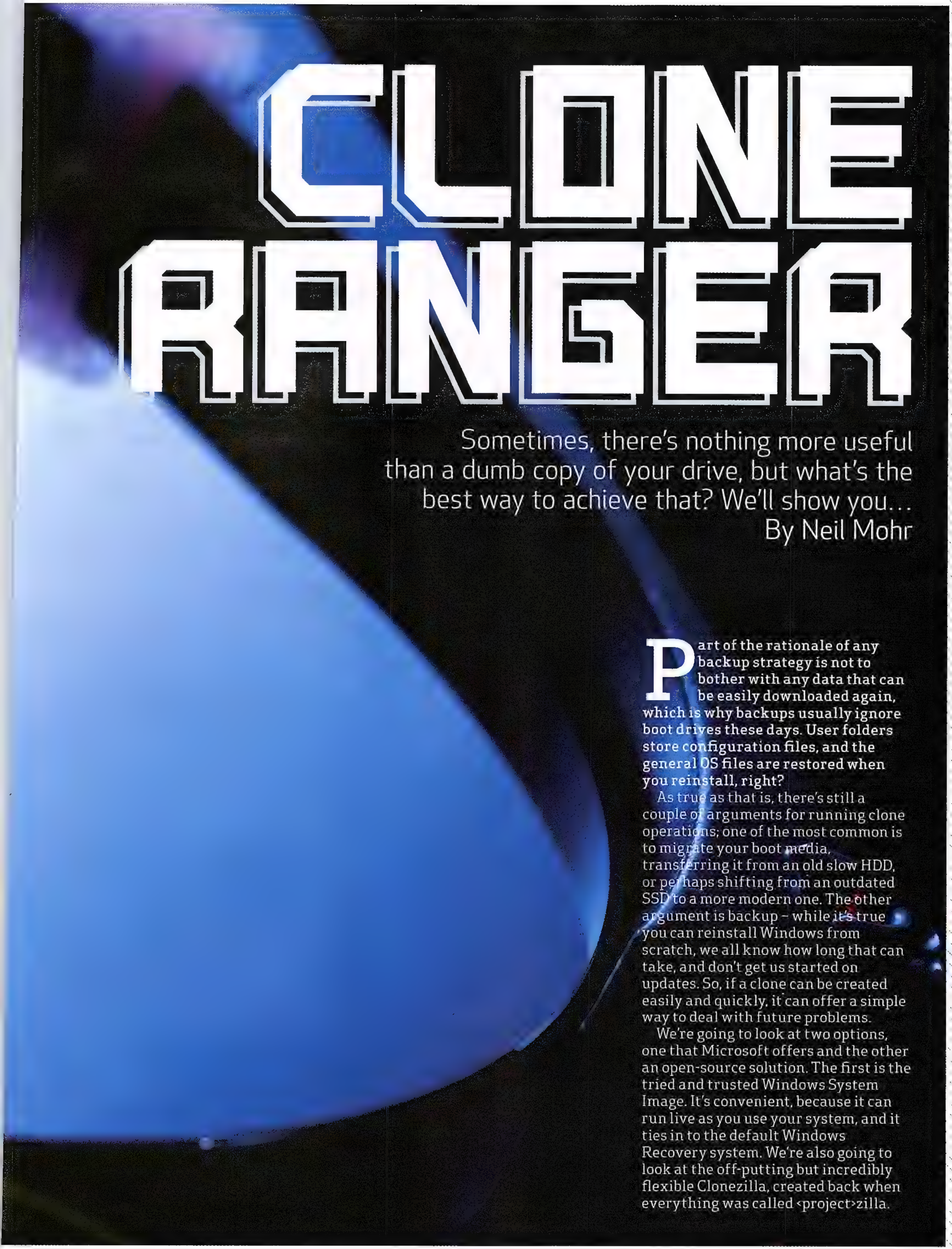
A working guide to building your own rudimentary PoE switch for the Pi Zero is at **http://n-o-d-e.net/tagged/howto** – find the entry for 11/01 marked 'How to power a Raspberry Pi Zero over Ethernet'. You'll need to source a USB Ethernet adaptor that works with the Pi Zero along with 12v-5v step-down convertor, two micro USB plugs and thin wires. It's a seven-step process that will require a soldering iron, clippers, wire strippers and needle nose pliers, and a handy YouTube video is provided to give you a visual guide to follow just incase.

INTEGRATE WITH OTHER IOT KIT

If you're looking to integrate your Pi into an existing IoT ecosystem, then the obvious choice if you're starting from scratch is Energenie thanks to its close integration with the Pi. On top of its own hub, sensors and other IoT-related gadgets there's the Pi-mote Control that allows you to remotely switch electrical sockets on and off using your Pi as well as a Mi|Home Adapter Plus that monitors the electrical consumption of an appliance attached to an Energenie smart power socket.

It's also possible to integrate your Pi into other ecosystems too. Visit GitHub (**https://github.com/nfarina/homebridge**) for a guide for emulating Apple's HomeKit API on your Pi, for example. Samsung's SmartThings API is another popular choice, and if you go to **https://github.com/nicholaswilde/berryio-smartthings** you'll find a way to bridge the two using BerryIO as an intermediary. There's a fair bit of work involved, and references to 'My Device Type' in the SmartThings setup process actually refer to the 'My Device Handlers' section. Nevertheless, it works, giving you remote control of your Pi through the SmartThings app among other things.

If all this feels like too much effort, there's one other way you can use your Pi with other devices – and that's through **IFTTT.com**, which enables you to combine devices and services using a series of triggers and actions in the form of recipes that easily cross the technology divide. Almost any IoT gadget worth its salt is represented here, and you basically call scripts from your Pi using the Maker channel. ■



CLONE RANGER

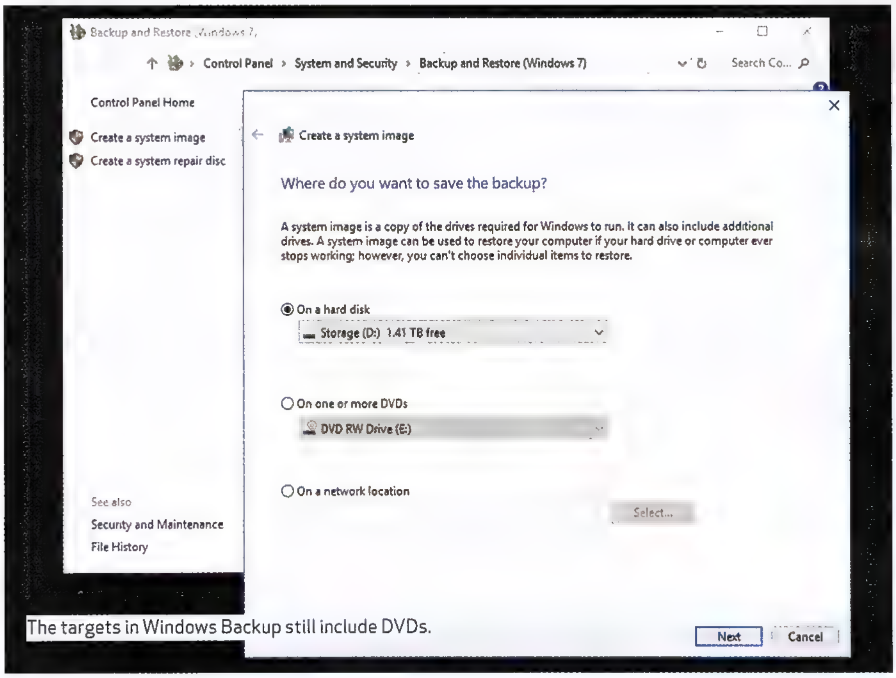
Sometimes, there's nothing more useful than a dumb copy of your drive, but what's the best way to achieve that? We'll show you...

By Neil Mohr

Part of the rationale of any backup strategy is not to bother with any data that can be easily downloaded again, which is why backups usually ignore boot drives these days. User folders store configuration files, and the general OS files are restored when you reinstall, right?

As true as that is, there's still a couple of arguments for running clone operations; one of the most common is to migrate your boot media, transferring it from an old slow HDD, or perhaps shifting from an outdated SSD to a more modern one. The other argument is backup – while it's true you can reinstall Windows from scratch, we all know how long that can take, and don't get us started on updates. So, if a clone can be created easily and quickly, it can offer a simple way to deal with future problems.

We're going to look at two options, one that Microsoft offers and the other an open-source solution. The first is the tried and trusted Windows System Image. It's convenient, because it can run live as you use your system, and it ties in to the default Windows Recovery system. We're also going to look at the off-putting but incredibly flexible Clonezilla, created back when everything was called <project>zilla.


Backup and Restore (Windows 7)
Control Panel › System and Security › Backup and Restore (Windows 7)
Search Co...
Control Panel Home
Create a system image
Create a system repair disc
See also
Security and Maintenance
File History
Create a system image

Where do you want to save the backup?

A system image is a copy of the drives required for Windows to run. It can also include additional drives. A system image can be used to restore your computer if your hard drive or computer ever stops working; however, you can't choose individual items to restore.

● On a hard disk
Storage (D:) 1.41 TB free

○ On one or more DVDs
DVD RW Drive (E:)

○ On a network location

The targets in Windows Backup still include DVDs.

Cloning or imaging? We really should get our parlance sorted before we continue. When most people think of imaging a drive, it's the process of copying an entire drive or partition to an image file stored elsewhere. In terms of drive cloning, people tend to think of "live imaging" of one drive or partition to another drive or partition on the fly.

Essentially, both processes are the same, it's just the destination that's different. Once a drive image is written to another drive, you've accomplished the same cloned state, just with an extra write step. To keep things simple, we'll call it all drive or partition imaging; if we're doing it disk-to-disk or disk-to-file, it's hardly going out of our way to say so.

Typically with backups, an incremental option should be available. This is a drive image that only stores the bytes that have changed, so it's quicker. Sounds useful, huh? Annoyingly, neither the Microsoft option nor the open-source tool support this, though it's not out of the question.

To be fair on Microsoft, imaging isn't a well-regarded way of backing up data these days, especially if you can't use an incremental system. It's time-consuming, and even considered pointless. If you have a boot drive larger than 240GB, you might want to consider another approach or repartitioning, so your user data is stored separately from Windows.

Unix-based operating systems nailed this aspect of separating user files from the OS a long time ago, insisting that all meat-bag data is stored (originally) in a dedicated / home folder, and in recent years on a / home partition. This enables the OS files to be nuked from orbit, reinstalled, and the world keeps on turning, because user files and config files are safely stored away from the detonation site. Windows 2000 did introduce something similar, but there's still an unholy mishmash of files all over the place. It's annoying.

THE MICROSOFT WAY

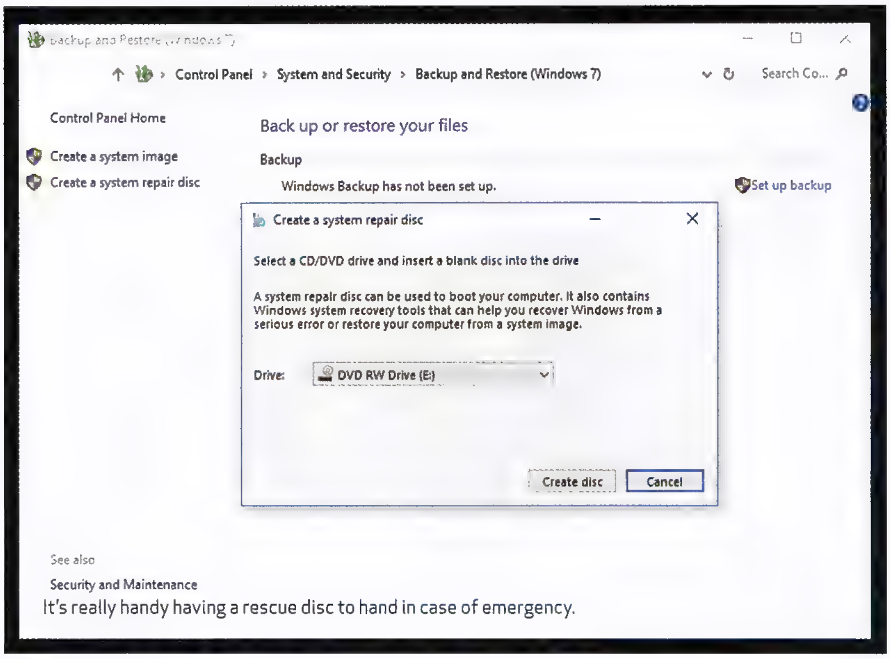
We're going to kick off by looking at the built-in Windows System Image tool. Microsoft tried to push people away from system images when it introduced Windows 8, in its not so subtle way of killing off Windows 7 Backup and Restore, which was originally introduced in Windows Vista. After much Gen-X moaning, Microsoft restored the system to Windows 8.1, and it remains tucked away in Windows 10 under the Control Panel section in "System and Security > Backup and Restore (Windows 7)."

In its favor, it's pretty straightforward to use, uses shadow copy to run in the background as you work, and the recovery (usually) works as part of the standard recovery mode options. The "usually" comment there is inserted as we have run into issues restoring images made under different versions of Windows – as in, it won't do that. Technically (and actually), you should make a recovery disc as a catch-all – you're prompted to do this when an image is completed.

Limitations with Windows System Image include: minimal options (it only images the entire system drive, and you can't restore individual files after); it only backs up to the root of a selected backup drive, and it only allows one image on there; it insists on a network username and password for network shares, even if they have public access rights (in this case, you need to provide the remote system's standard username and password); and, as mentioned, it doesn't support incremental backups, so it always takes a long time to run.

Creating a disk image with Microsoft System Image is pretty easy, but you need a separate internal drive, a spare external drive, a big stack of DVDs, or a network share to which you know the username and password. Got that sorted? Good!

In "Search," type "Control," and select "Control Panel." Under "System and security," click "Backup and Restore (Windows 7)," and click "Create a system image" on the left. It scans for


Backup and Restore (Windows 7)
Control Panel › System and Security › Backup and Restore (Windows 7)
Search Co...
Control Panel Home
Create a system image
Create a system repair disc
See also
Security and Maintenance

Back up or restore your files

Backup

Windows Backup has not been set up.

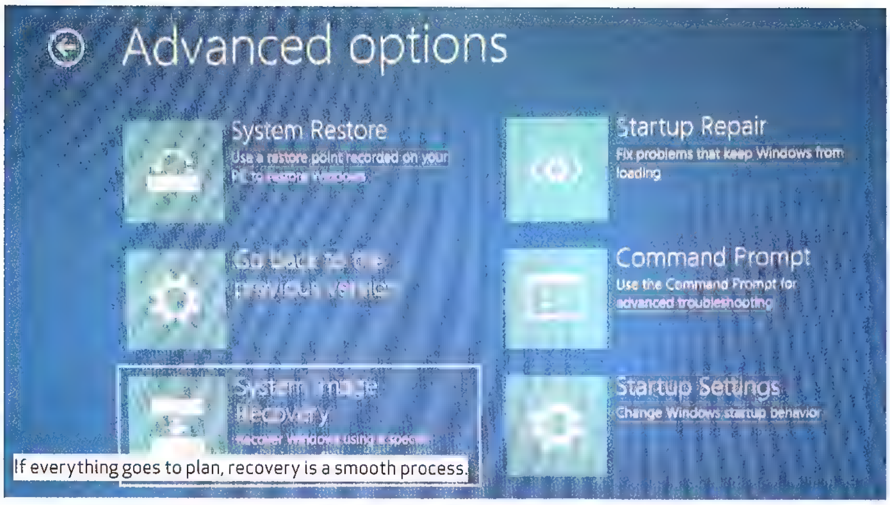
Set up backup
Create a system repair disc

Select a CD/DVD drive and insert a blank disc into the drive

A system repair disc can be used to boot your computer. It also contains Windows system recovery tools that can help you recover Windows from a serious error or restore your computer from a system image.

Drive: DVD RW Drive (E:)

It's really handy having a rescue disc to hand in case of emergency.


Advanced options
System Restore
Use a restore point recorded on your PC to restore Windows
Startup Repair
Fix problems that keep Windows from loading
Go back to the previous version
Command Prompt
Use the Command Prompt for advanced troubleshooting
System Image Recovery
Recover Windows using a specific
Startup Settings
Change Windows startup behavior

If everything goes to plan, recovery is a smooth process.

what it considers viable backup targets. An external drive or network share would be best, though any internal drive is fine; as mentioned, though, for any network share, even if it's set for guest access, you need to provide a suitable username and password. If everything appears to work, click "Next." You're provided with an estimate of the space requirements and a "Start backup" button. Hit that, and you can continue life as normal, while the drive is imaged in the background.

To recover your PC, you have two options: reboot using a recovery DVD, or start Windows in Recovery mode. If Windows runs, open the "Start" menu, type "Recovery," and choose "Recovery options." Select "Restart now" under "Advanced startup." Choose "Troubleshoot > Advanced options > System image recovery." Windows then reboots into Recovery mode. You need the drive with the system image on plugged in to your computer. Follow the prompts, and your system is restored.

THE OPEN WAY

So, the Microsoft tool is limited and slow, but it has saved our bacon a couple of times over the years. We look at other proprietary options in the box below, but we'd like to focus on the long-standing industry tool Clonezilla. In development since in 2007, it's an enterprise-class disk-imaging and restore tool, with support for over 20 filesystems, over six operating system types, and sector-to-sector copy for those it doesn't support. It has full network support, a client-server mode, and supports full encryption of its images. It's beyond the scope of this article, but it also supports Multicast for multi-clone/restore to networked systems, with PXE and WoL support.

That's all nice, but it means Clonezilla is more complex to use. It's not helped by the fact that it has its roots in the Linux garden, so text-based interfaces and indecipherable drive names are the order of the day. The flip side is that it's super-flexible, and free to use anywhere and on anything. And once you've run through the menu systems, you soon learn what's important and what can be ignored.

Clonezilla is a "live disc" OS, which means you grab the ISO image from **www.clonezilla.org**, and write it to either a CD, DVD, or USB stick. You then boot your system off that. Get the "Alternative Stable" image, aka Ubuntu-based build, from **www.clonezilla.org/downloads.php** – it's about 220MB. This version can avoid potential UEFI boot issues on new systems. If you want to write this to a USB stick, the latest tool to do that is Etcher.io. Gather all that together, write it to the USB stick, and come back when you're ready.

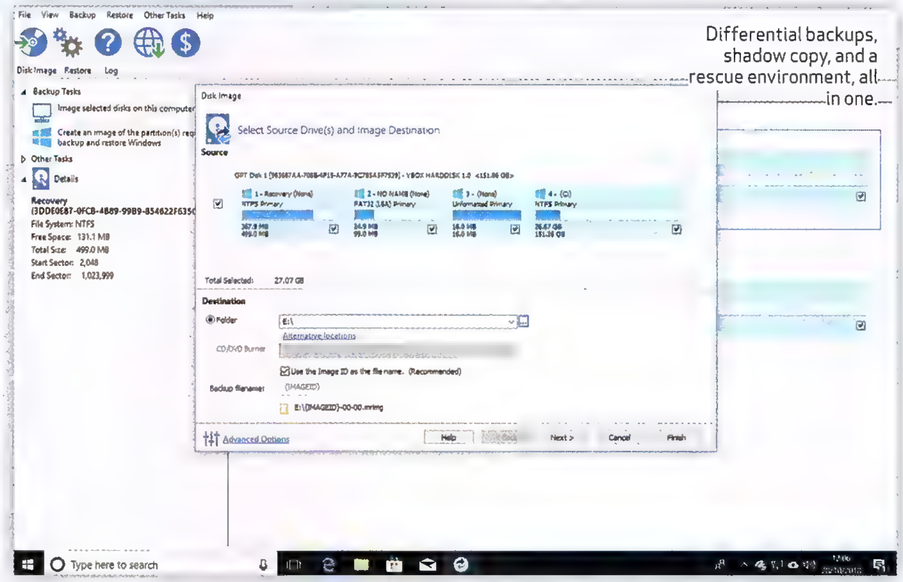
Now work out how to boot your PC from a USB device – many systems

GIVE ME A GUI!

We're the first to admit that Clonezilla isn't the prettiest thing to look at, nor the easiest in terms of understanding what it's asking you half the time. In the past, both **www.easeus.com** and **www.macrium.com** have offered solid free imaging tools, and certainly sell excellent commercial solutions.

If you're looking for a free option, Macrium Reflect Free Edition is probably your best bet. Once installed – there's an initial 5MB installer download, followed by a 800MB main download – you can simply select "Backup > Windows," and it backs up your full boot drive (boot, Windows, and recovery partitions) in a simple fashion. It also supports differential backups, so once the main imaging is finished, further backups will then take much less time.

Unlike Clonezilla, which has to be run off a bootable device, you need to create a recovery disc with Macrium Reflect. You can do this if your system fails to boot, but it's more useful to have the system in place beforehand. This is done via "Other Tasks > Rescue Media Wizard," and Macrium calls it a Windows PE rescue environment. Click "Change PE Version" to see the issue with older versions of Windows; effectively, Windows 10/8.1/8/7/Vista/XP need different versions to work, which complicates restoring older versions.



Differential backups, shadow copy, and a rescue environment, all-in one.

offer an early "Boot" menu, accessed by tapping F9 (HP), F12 (Dell, Lenovo), F8 (Amibios), or F11 (Award BIOS) while it runs the power-up POSTs; otherwise you need to hit Del, and fiddle with your boot device priority settings in the BIOS/UEFI.

If all has gone well, you're presented with the glorious text-based screen shown below. A rule of thumb here is to use the defaults – you can't really go too wrong. We're going to take you through creating an image of your boot drive and restoring that. We'll talk about live imaging drive-to-drive, and in the box on the left, we cover networked imaging, because Samba networking takes a couple more steps to set up.

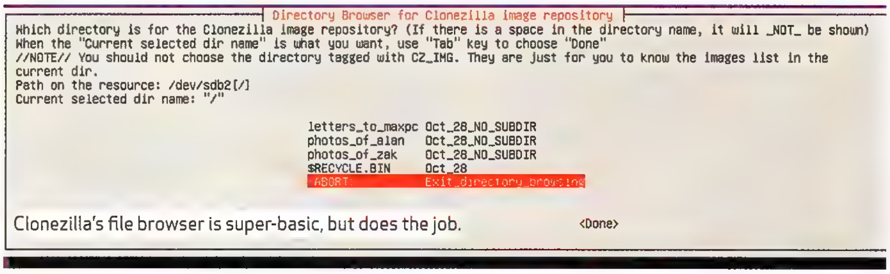
Going through the menu, "800x600" is more than enough pixels for anyone, then "English language," "Default US keyboard layout," and "Start Clonezilla." Then you land at the first menu of import. Use the up/down arrow keys to move up and down; switch between "<OK>," "<CANCEL>," and main menu options with the Tab key; and if you need to select multiple items, do that with the space bar.

Choose "device-image" or "device-device" mode – we're not covering the other options. We're selecting "device-image" first, so hit Enter. Next, choose the location of the image file; we're using "local_dev" (local storage device), so tap Enter. For network access, you'd select "samba_server," while if you have accounts for Amazon S3 or OpenStack, they would be useful for remote backups.

At this point, it prompts you to plug in your USB device. Wait five seconds, then press Enter. It now lists all the suitable devices it can detect; this should include the source drive you want to image, and the target drive where you want to store the image. The list uses modern Linux parlance, such as "/dev/sda VBOX_HARDDISK VBOX_HARDDISK_<LONG HEX NUMBER> 163GB." The initial "/dev/sdX" is the human-readable system label for the drive; the first name is the detected hardware device name; and the long name containing hexadecimal is the unique OS label, ending with the total capacity.

If those look correct, press Ctrl-C, and Clonezilla scans for partitions. This results in another overly complex-looking list. You should recognise the device labels "sda," "sdb," and so on that denote drives, while the partitions on

> "If all has gone well, you're presented with the glorious text-based screen shown below. A rule of thumb here is to use the defaults – you can't really go too wrong."

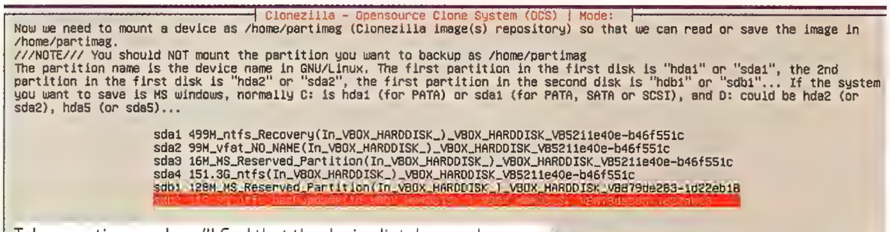


```
                   ┤ Directory Browser for Clonezilla image repository ├
Which directory is for the Clonezilla image repository? (If there is a space in the directory name, it will _NOT_ be shown)
When the "Current selected dir name" is what you want, use "Tab" key to choose "Done"
//NOTE// You should not choose the directory tagged with CZ_IMG. They are just for you to know the images list in the
current dir.
Path on the resource: /dev/sdb2[/]
Current selected dir name: "/"

                         letters_to_maxpc Oct_28_NO_SUBDIR
                         photos_of_alan   Oct_28_NO_SUBDIR
                         photos_of_zak    Oct_28_NO_SUBDIR
                         $RECYCLE.BIN     Oct_28
                         ABORT            Exit_directory_browsing

                                              <Done>
```

Clonezilla's file browser is super-basic, but does the job.

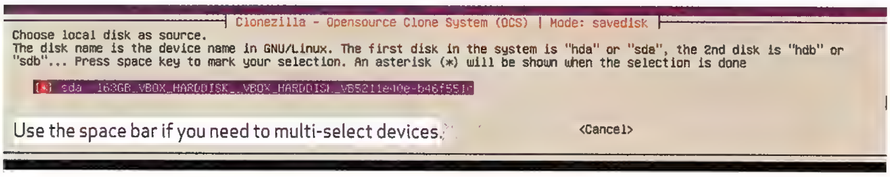


```
                    ┤ Clonezilla - Opensource Clone System (OCS) | Mode: ├
Now we need to mount a device as /home/partimag (Clonezilla image(s) repository) so that we can read or save the image in
/home/partimag.
///NOTE/// You should NOT mount the partition you want to backup as /home/partimag
The partition name is the device name in GNU/Linux. The first partition in the first disk is "hda1" or "sda1", the 2nd
partition in the first disk is "hda2" or "sda2", the first partition in the second disk is "hdb1" or "sdb1"... If the system
you want to save is MS windows, normally C: is hda1 (for PATA) or sda1 (for PATA, SATA or SCSI), and D: could be hda2 (or
sda2), hda5 (or sda5)...

             sda1 499M_ntfs_Recovery(In_VBOX_HARDDISK_)_VBOX_HARDDISK_VB5211e40e-b46f551c
             sda2 99M_vfat_NO_NAME(In_VBOX_HARDDISK_)_VBOX_HARDDISK_VB5211e40e-b46f551c
             sda3 16M_MS_Reserved_Partition(In_VBOX_HARDDISK_)_VBOX_HARDDISK_VB5211e40e-b46f551c
             sda4 151.3G_ntfs(In_VBOX_HARDDISK_)_VBOX_HARDDISK_VB5211e40e-b46f551c
             sdb1 128M_MS_Reserved_Partition(In_VBOX_HARDDISK_)_VBOX_HARDDISK_VB879de283-1d22eb18
             [illegible]

                                              <Cancel>
```

Take your time, and you'll find that the device list does make sense.



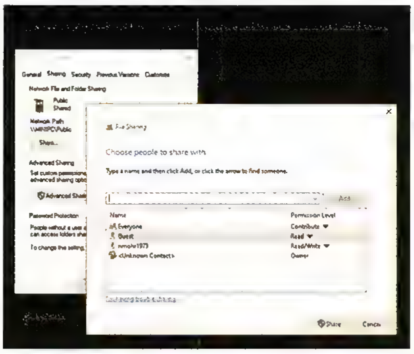
```
                  ┤ Clonezilla - Opensource Clone System (OCS) | Mode: savedisk ├
Choose local disk as source.
The disk name is the device name in GNU/Linux. The first disk in the system is "hda" or "sda", the 2nd disk is "hdb" or
"sdb"... Press space key to mark your selection. An asterisk (*) will be shown when the selection is done

   [*] sda  163GB_VBOX_HARDDISK__VBOX_HARDDISK_VB5211e40e-b46f551c

                                              <Cancel>
```

Use the space bar if you need to multi-select devices.

Problems logging in to a share? Check it has the right permissions.



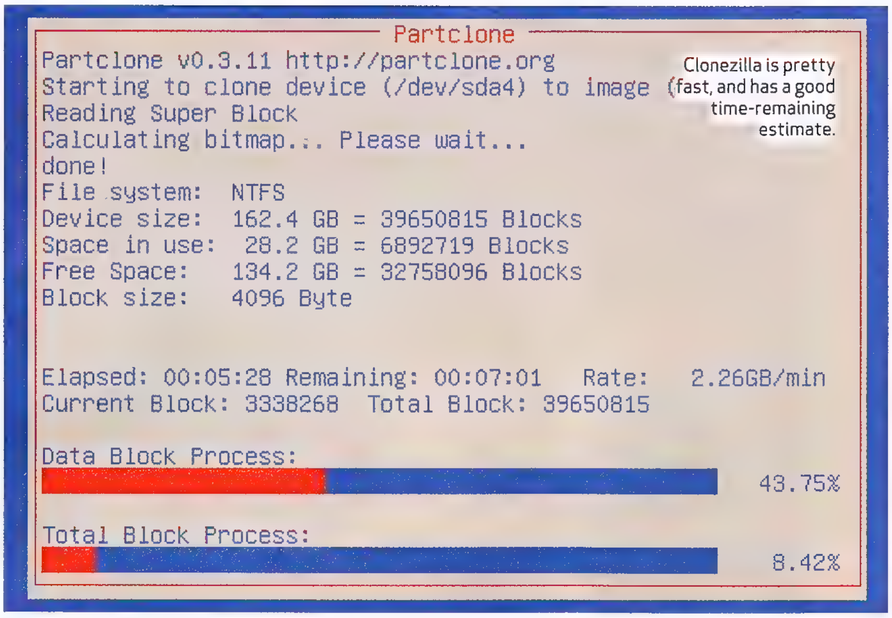
DO THE SAMBA

Clonezilla supports a number of networked backup and restore options – the one most likely to be relevant to you is Samba. That's the crazily named open-source implementation of the Windows networking protocol. The option pops up after you pick the type of backup/restore mode to use, and at the Image Directory point. Choose "samba_server," then the next few steps require you to know the IP address of the target system, plus have a Windows username and password for it. We also suggest creating a public/guest-accessible folder to save the images to. You still need the username and password for the main account, or create a new user for the backup task.

If you don't know the IP address, assuming you can access the target networked machine, type "ipconfig" in a command prompt, then press Enter – IPv4 is the address you need. Alternatively, use a tool such as Fing on an Android phone to scan your network and return the IP address of the PC.

After selecting "samba_server," choose "DHCP," as that should be how your network is configured to hand out IP addresses. It runs a scan, then asks for the IP address or FQDN of the server—you need the IP address of the target PC. Ignore the "Domain" request. Replace "administrator" with the username, replace "/images" with the shared folder name – "/public," for example. When it asks for the Samba version, the default 1.0 is fine. Select "Auto use system default" for security. At this point, it asks for the password so it can try to log in.

If you get login errors, check you typed the password correctly (it's case-sensitive). Also check permissions on the Windows share, and that it is accessible by the user account—one way to check is to right-click the shared folder, then select "Properties > Sharing > Share," and check the permissions.



```
Partclone
Partclone v0.3.11 http://partclone.org
Starting to clone device (/dev/sda4) to image (
Reading Super Block
Calculating bitmap... Please wait...
done!
File system:  NTFS
Device size:  162.4 GB = 39650815 Blocks
Space in use:  28.2 GB = 6892719 Blocks
Free Space:   134.2 GB = 32758096 Blocks
Block size:   4096 Byte

Elapsed: 00:05:28 Remaining: 00:07:01   Rate:   2.26GB/min
Current Block: 3338268  Total Block: 39650815

Data Block Process:
                                                    43.75%

Total Block Process:
                                                     8.42%
```

Clonezilla is pretty fast, and has a good time-remaining estimate.

each drive are numbered "sda1," "sda2," and so on for one drive, and "sdb1," "sdb2," etc. for the next drive. Each following label consists of "<capacity>_<file system>_<drive label>_<device name>_<OS Unique ID>." Select the target drive to save the image to; if you've named it, look for the "<drive label>" section. Select it, then press Enter.

You're presented with a "Directory Browser." If your backup drive is blank, it just has a confusing "<ABORT>" selection, but if you have sub-directories, these are listed and selectable. Don't worry – each image creates its own folder anyway. Tap Tab twice to select "<DONE>," then press Enter to use the root to store images.

Select "Beginner" mode, then we need to select the backup style. To keep things simple, we're going to focus on "savedisk," as in the entire drive – for a typical Windows boot drive, this is three partitions, which you want to save: boot partition, OS partition, and a recovery partition. If you're recovering your image, select the "restoredisk" or "restoreparts" option – notice the "1-2-mdisks" option, which enables multi-disk restoration if you're doing a mass clone. Press Enter to get this show on the road. Keep the default date-based name. Finally, select the drive (or partitions, if that's the option you've chosen) to image, then press Enter.

There's a final batch of options to go through. Choose "-sfsck" to skip disk checking (it doesn't work well on NTFS filesystems anyway); choose to verify the final image; encrypt the image for security if you want, but you need a strong password; and it offers to power down when done. Hit Enter twice to get started. There's a final "Press (y/n)" to get started, before a detailed progress display is shown. Even on older spinning drives, imaging a boot drive shouldn't take much longer than 15 minutes, unless its capacity is in the terabyte range. SSD scenarios are significantly faster.

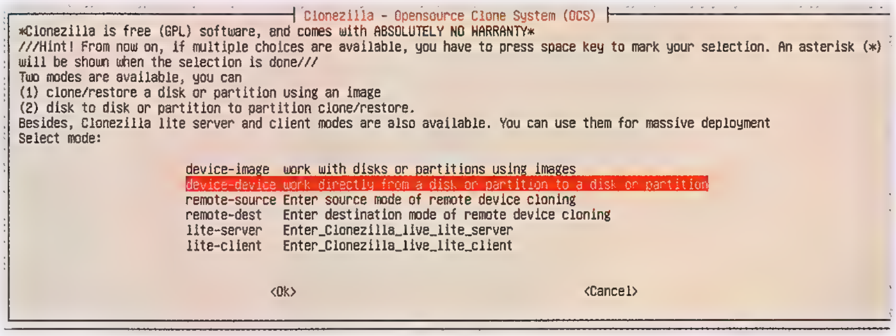
Restoration of a drive is exactly the same – the advantage for Clonezilla is the images are always compatible, you can easily get a fresh ISO to boot from, and images can be stored anywhere, even in the cloud – just after the "Beginner" mode selection, choose "Restoredisk" mode.

Disk imaging isn't a cure-all backup solution, but it can help get a system back up faster than reinstalling, and is a real time-saver for deployment scenarios. ■

DRIVE CLONING

It's worth taking a quick detour to specifically cover drive migration, cloning, or drive-to-drive imaging. With SSD prices currently falling through the floor, if you've got an older system still running spinning rust or stuck on an outdated, smaller SSD, this is the ideal time to migrate it to a larger, faster new SSD. Copying system files can be off-putting, but with Clonezilla, it's a cakewalk.

Of course, there are some points we need to cover first. The new drive has to be as large as the original drive, at least in terms of space. You can use the Windows Disk Management console to attempt to shrink partitions, but you may need to delete files to make room, too. Search for "Disk Management," and select the "Create and format" option. Right-click your C: drive, and choose "Shrink" to see if it'll reduce enough in size. If you're moving from an old HDD to a new SSD, this could very likely be the case; you might be better mass-moving a host of user files to a backup drive, and taking it from there.



Migrating an entire drive is very easy to do.

```
Clonezilla - Opensource Clone System (OCS)
*Clonezilla is free (GPL) software, and comes with ABSOLUTELY NO WARRANTY*
///Hint! From now on, if multiple choices are available, you have to press space key to mark your selection. An asterisk (*)
will be shown when the selection is done///
Two modes are available, you can
(1) clone/restore a disk or partition using an image
(2) disk to disk or partition to partition clone/restore.
Besides, Clonezilla lite server and client modes are also available. You can use them for massive deployment
Select mode:

                    device-image  work with disks or partitions using images
                    device-device work directly from a disk or partition to a disk or partition
                    remote-source Enter source mode of remote device cloning
                    remote-dest   Enter destination mode of remote device cloning
                    lite-server   Enter_Clonezilla_live_lite_server
                    lite-client   Enter_Clonezilla_live_lite_client

             <Ok>                                    <Cancel>
```

You need to power down your system and attach the new drive to which you want to migrate. To avoid catastrophic data loss, you might want to remove any unnecessary drives, to avoid wiping them by mistake.

You need to use Clonezilla's device-to-device mode, rather than the individual partition option – this is the "disk_to_local_disk" option, rather than "part_to_local_part." It might seen cunning just to duplicate the Windows partition, but that omits the bootloader – either MBR or GTP – leaving the clone unbootable.

The next step lists all the detected storage devices. It's vital that you choose the correct "Source," and then the correct "Target," otherwise you'll nuke your boot drive. Once you confirm, Clonezilla starts duplicating the entire device. If the new device is larger, check "Disk Management" to see whether it will expand the partition to fill any free space.

HYPER X
SAVAGE
INTEL SO
750 SERIES

SOLID STATE OF THE NATION

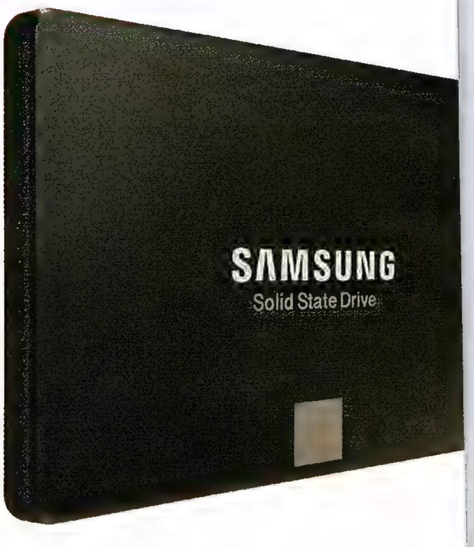
With SSD prices at an all-time low, Jeremy Laird evaluates your solid-state storage options.

Are SSDs finally cheap enough to qualify for mass storage? As we go to press this issue, that's surely an affirmative. Compared to the prices of the first mainstream consumer SSDs of a decade ago, you now get over 10 times the storage for about one quarter of the money. Back in 2008, an 80GB drive from a major brand would set you back around $600. Today? Prices for solid-state drives in the 240GB to 256GB class kick off around $60. For 480GB to 512GB models? Make that about $100.

Granted, you'd be brave to bag one of the cheaper options from lesser-known brands. But big-brand, full-featured 1TB SSDs can currently be had for as little as $320. For many PC users, that's both cheap enough and large enough to be considered viable for the mass storage of data. Of course, if you need major quantities of memory or simply want to absolutely maximise your storage space for as little money as humanly possible, traditional magnetic drives remain your weapon of choice. But a terabyte or three is enough for most of us, and in that context, solid state is now a serious option.

If that sounds like a simple sales pitch for solid state, the practical reality of choosing a drive is way more complicated. SSD technology has progressed beyond recognition since the first mainstream consumer drives hit the market ten years ago or so. With that progression has come complication. Put simply, there's way more to a good SSD than impressive peak read and write numbers. In terms of the end user experience, other factors, including latency and random access, can be more important. Endurance and longevity – and how those issues map to both drive technology and usage scenarios – matter, too.

Intel's X25-M marked the arrival of consumer SSDs.



SATA limits SSD performance, but remains a popular choice.

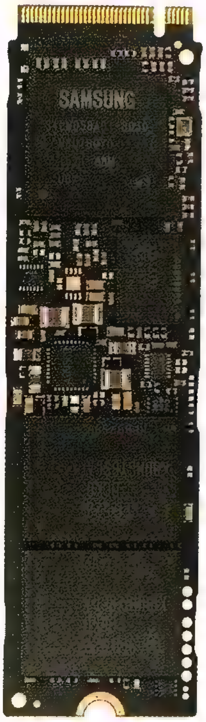
Even at the component level, let alone full retail drives, there are far more vendors of SSD controllers and memory chips than there are makers of graphics chips and CPUs. It's tough to keep up with all the options. Likewise, working out how to actually judge the performance of an SSD is far more complicated than for other core components. But that's OK, because we're here to give you the low-down on the current solid state of the nation.

FLASH SALE

Wind the clock back to fall 2008, and the arrival of Intel's hot new X25-M solid-state drive. It wasn't the first SSD aimed squarely at the consumer market, but it did mark the arrival of SSDs based on NAND flash memory as a consumer technology, albeit at a price. The aforementioned 80GB drive for $600? Yup, that was an Intel X25-M.

Anyway, what matters is that the X25-M and its early-SSD siblings seemed like the final piece of the puzzle for achieving the holy grail that is the solid-state PC. Kiss goodbye to magnetic hard drives with spinning platters.

It's easy to forget just what a revolutionary leap it was to move from traditional hard drives to solid state. Moving parts, put simply, mean latency and unreliability. As it turned out, however, the step change to solid-state storage didn't go smoothly. After basically blowing everybody's socks off with HDD-battering headline performance numbers, it quickly became apparent that something was rotten in the solid state of Denmark. To be fair, the Intel X25-M wasn't the first problematic SSD, and it wouldn't be the last. But it was a very high-profile representative of the breed.



M.2 is now the default option for high-performance SSDs.

The problem is that the performance of SSDs configured with NAND flash memory degrades over time. The reason goes something like this: NAND flash memory is made up of cells. These cells are arranged in a hierarchical fashion. Individuals cells are arranged into strings and, in turn, arrays. These arrays make up pages, at which point the overall number of cells typically clocks in at 32,000–128,000 per page. Those pages are arranged into yet larger blocks, which ultimately measure in megabytes.

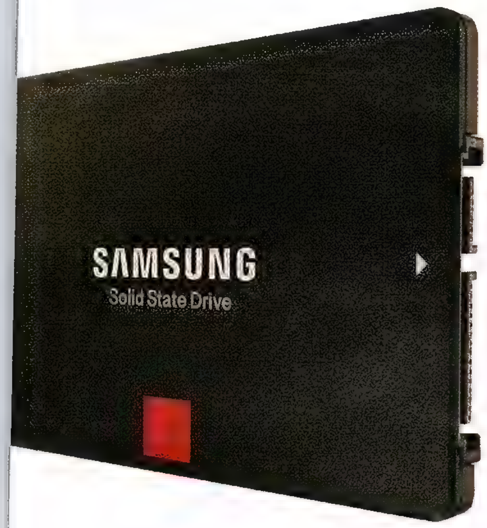
So what, you ask? Here comes the kicker. While NAND memory can be read and written in pages, it can only be erased in whole blocks. The reason for that is complex, and involves voltage levels and minimising errors. But the impact on performance is sobering. Writing to empty memory cells is a breeze. But overwriting existing data is far more laborious. All data from the relevant block must be copied to a cache memory, the full block is erased, and then rewritten with the modified data.

As a drive approaches full capacity, and the availability of empty cells, arrays, pages, and blocks dwindles, it's not hard to see how this impacts performance. But even when a drive has significant free capacity, performance can be dramatically compromised. Again, it comes down to the fact that only full blocks can be erased. The consequence is that, in the first instance, when pages within a block are deleted at operating system level, on the drive they're only marked as dead or redundant. To actually erase those pages would require erasing the whole block, and thus caching and rewriting any pages that retain live data. It's therefore expedient in the short term to simply mark pages as containing redundant data rather than erase them.

The long-term result is that, as an SSD fills up, juggling data becomes ever more laborious. A nearly full drive involves lots of long-winded read, cache, erase, modify, and write processes. But the same applies – or at least did apply—to a heavily used drive with lots of spare space. The upshot of it all back in 2008 involved very expensive SSDs that became stuttering, almost useless lumps of silicon.

Several mitigating technologies have since emerged, including intelligent

Samsung Evo 860 (left); Samsung Pro 860 (right). The SSD was the final piece of the solid-state PC puzzle.



garbage collection and the TRIM command, that largely solve the problem of extreme SSD performance degradation. But the saga remains significant in the sense that it presaged a broader problem. Assessing SSD performance is much more complicated than merely measuring peak throughput from a box-fresh drive.

Hold that thought. We'll come back to the question of how SSD performance and indeed SSD benchmarking has developed since those early days. First, let's consider the current state of the SSD market, and have a look at all the technologies and options available.

The very basics of SSDs involve form factors and interfaces. Currently, two options dominate. The first comprises drives contained in 2.5-inch enclosures and hooked up via the legacy SATA interface, courtesy of cables. More recently, drives presented on 22mm-wide bare circuit boards, and which communicate predominantly over the PCI Express interface, have become popular, and are known as M.2.

SATA-based drives are most obviously limited in terms of bandwidth. The latest SATA III spec tops out at a practical maximum of 600MB/s. M.2 and indeed other PCI Express-powered drives are limited by the number of PCIe lanes they utilise. M.2 drives currently max out at four PCIe 3.0 lanes, and so 3.9GB/s of practical, usable bandwidth. Lesser-seen options include SSDs configured as pure PCIe cards and U.2 drives, the latter theoretically combining the best of both SATA and PCIe, but they haven't caught on in desktop systems.

Crucial's MX500 is an obvious SATA budget option.

MORE OR LESS MAINSTREAM

When it comes to value SSDs, there's such a thing as false economy. A cheap drive from an unknown brand looks great on paper, with plenty of capacity and appealing performance numbers. But therein lies danger.

Engineering a flash-based SSD that delivers good long-term performance and reliability is no simple task. It requires deft integration of multiple components and quality coding of the drive's firmware. Specifically, one of the major challenges includes effective garbage collection that mitigates the inherent loss of performance over time as NAND blocks fill with data. For that you need a quality controller chip and good firmware algorithms. Bigger brands can invest in such technologies and share the cost over a wide range of products.

Another problem for cheap drives involves the related issues of over-provisioning and cache memory. Over-provisioning of memory allows a drive to maintain capacity even as wear causes cells to fail. It also allows a chunk of memory to operate in faster single-level cell mode. The very cheapest drives typically offer limited over-provisioning for wear and to act as SLC cache. While we're talking cache, cheap drives often also omit a DRAM cache, which will further impact their performance.

With all that in mind, what do we recommend? In the 2.5-inch SATA market, we would go for the Crucial MX500. It's a little more expensive than its BX500 sibling, but it's properly configured with both DRAM and dynamic SLC cache. Expect to pay about $80 for a 250GB drive and $110 for the 500GB version. 1TB is yours for around $210.

Intel's Optane drives are setting new standards for responsiveness.

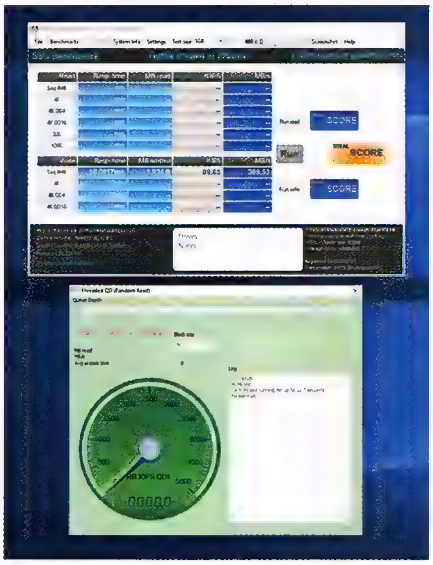
Further nuance involves control protocols. Long story short, the legacy AHCI protocol used in conjunction with the SATA interface was never conceived with solid-state drives in mind. However, the newer NVMe (Non Volatile Memory Express) protocol solves that problem, and helps make the most of the theoretical advantages of solid-state tech, especially with random access performance. Most but not all M.2 drives support NVMe, so bear that in mind when shopping.

TAKE IT ON BOARD

Of course, motherboard support is central to much of this. Older boards do not have M.2 slots. The good news is that converter cards for M.2 SSDs that plug into standard PCI Express slots are available. But remember that legacy motherboards may not play nicely with newer SSDs, especially those that utilise the NVMe protocol. Our advice for any motherboard that does not have an M.2 slot is to check support for booting from NVMe drives before assuming it's present.

It's also worth considering platform support for PCIe-powered drives, generally. With Intel's mainstream and mobile platforms, M.2 slots are hooked up via the chipset, rather than directly to the CPU's own PCIe lanes. That means the drives ultimately communicate with the CPU via the DMI bus. As it happens, the current implementation of the DMI bus is effectively a quad-lane PCIe 4.0 connection by another name. Problem is, of course, the DMI bus carries all chipset bandwidth, including USB, legacy storage, networking traffic, and potentially multiple M.2 SSDs.

You can get around that limitation by using a pure PCI Express SSD or a PCI Express M.2 adapter card that drops into one of the available x16 PCI Express slots, and thus connects directly to the CPU. However, because Intel's mainstream desktop processors only have 16 available PCI Express lanes, using both PCIe16 slots means dropping any installed graphics card down from 16 to eight lanes, which could impact gaming performance in extreme circumstances. However, for both Intel's high-end desktop and all of AMD's existing desktop platforms, there are enough available direct-to-CPU lanes to maintain a full 16-lane graphics interface alongside a quad-lane PCI Express storage solution.

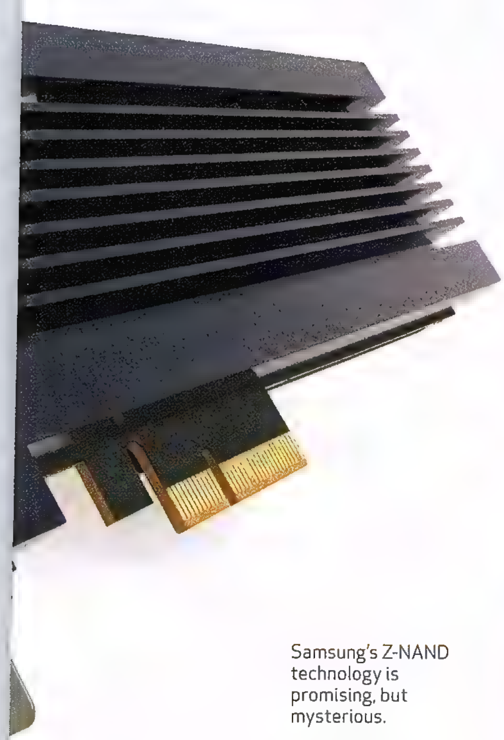


Real-world SSD performance is about much more than raw throughput.

The final motherboard-related concern is to ensure you have an optimal configuration. When boards offer multiple M.2 slots, they may not be equal in terms of PCI Express lanes. What's more, not only will slots share the DMI link on a mainstream Intel board, as mentioned above, but they will conflict with the SATA storage bus. Put simply, with any given motherboard, there will be both limitations to and optimal configurations for connecting a mix of M.2 and SATA drives. Consult your motherboard manual for more information.

Next up is the actual technology used for the memory chips in an SSD. For better or worse, conventional NAND flash memory remains by far the dominant non-volatile memory technology in SSDs. Intel's Optane and Samsung's Z-SSD drives, it's true, offer potentially revolutionary non-volatile memory alternatives in the shape of 3D Xpoint and Z-NAND, respectively. However, it's early days for both technologies (see "The Future of SSDs" boxout).

But even among NAND SSDs, there is now a dizzying array of memory cell technologies. Just for starters, you've got SLC, MLC, TLC, and QLC NAND. Respectively, each technology can store one, two, three, and four bits of data per memory cell. The benefits of increasing per-cell capacity are obvious enough—more capacity for less die space, and so lower cost. But as cell density increases, there are trade-offs.



Samsung's Z-NAND technology is promising, but mysterious.

Firstly, endurance falls off a cliff. SLC or single-level cell NAND flash memory is good for as many as 100,000 program-erase cycles before a given memory cell loses its ability to store data. That falls to 1,000 for the latest QLC NAND. That's a huge drop-off in endurance.

Then there's performance. For a QLC memory cell, reading and writing the contents of a cell means distinguishing between and applying 16 possible voltage levels. Long story short, reading and writing to multi-level NAND cells is an increasingly laborious process as per-cell density increases.

ALGORITHM SECTION

Inevitably, mitigating technologies that offset both the loss of endurance and performance as cell density increases have emerged. Wear-leveling algorithms ensure that writes are spread evenly across the drive, while over-provisioning of memory means any given drive can tolerate a certain amount of cell failure before available capacity begins to shrink. Such measures are good enough for Crucial to rate its new QLC-powered drive, the P1, with a mean time to failure of 1.8 million hours, and an overall write endurance of 200TB, which should be plenty for most consumers.

Performance, meanwhile, is much improved by allocating a large chunk of the memory as a cache running in much faster SLC mode. But as the drive fills up and eventually eats into that SLC cache, performance begins to tail off. It's another example of how SSD performance isn't entirely straightforward. It also helps to explain

PREMIUM PERFORMANCE

When it comes to M.2 NVMe SSDs based on flash memory, we're not going to pull any big surprises. Samsung's 970 Pro, available in 512GB and 1TB formats for $230 and $480 respectively, is our pick of the premium M.2 drives. Its advantage over the competition isn't enormous, but it's still the winner – just by a smaller margin.

Its core specifications are the chief reason why the 970 Pro is so good. For starters, it uses Samsung's hottest 64-layer 3D MLC NAND memory, where the 970 Evo uses cheaper but ultimately slower 3D TLC NAND. Then it packs at least 512MB of LPDDR4 DRAM cache. Finally, there's Samsung's very latest and greatest controller chip and firmware combo, known as Phoenix.

The net result? Sequential read speeds of 3.5GB/s that pretty much saturate the quad-lane M.2 interface. It's about as good as it gets for 4K random read performance at low queue depths, too. As good as it gets, that is, for a NAND flash drive. Unfortunately for Samsung, Intel has finally begun to deliver with its 3D Xpoint technology, now branded Optane. Which is why our money-no-object recommendation is the Intel Optane 905p 1.5TB.

It costs a preposterous US$3,200. It doesn't even offer the highest peak sequential speeds. But it's almost certainly the fastest SSD you can buy in terms of real-world performance where it matters.

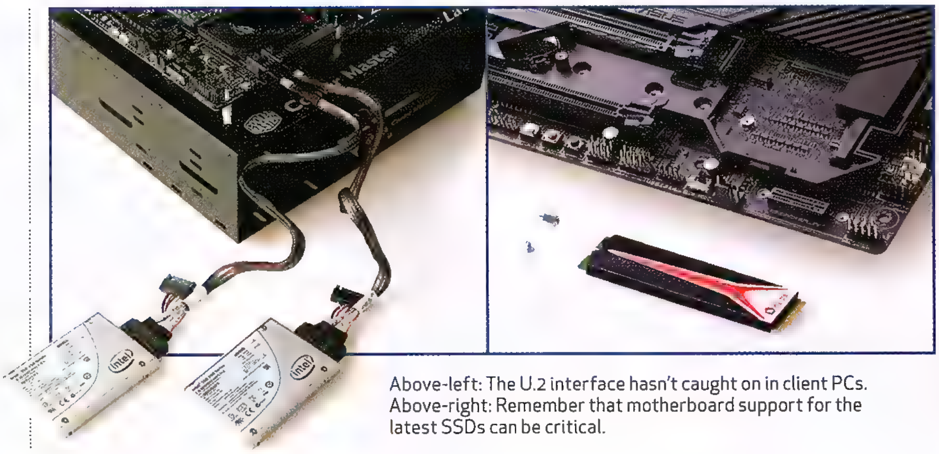
Most obviously, the 905p absolutely kicks butt when it comes to latency and low queue depth 4K random access performance. So, yes, the Samsung 970 Pro edges it by about 10 percent when it comes to sequential reads, but the 905p absolutely monsters the Samsung when it comes to single queue depth 4K reads – it's 300 percent faster. Combine that with the lowest latencies in the business, and you have the snappiest-feeling SSD on the planet. It's just a pity that it costs quite so much.

why big, cheap drives are inevitably slower.

As for 3D NAND memory, that's available in multiple per-cell densities just like standard 2D NAND, but involves multiple layers of memory cells, each atop the others, instead of a simple planar 2D array of cells. Apart from the obvious benefits for memory density, 3D NAND also has inherent performance and endurance advantages. That's why Samsung's fastest NAND-based SSDs, including the 970 Pro, use 3D NAND.

Aside from interfaces, control protocols, and memory type, SSD controller chips are another major determining factor when it comes to performance. Unfortunately, relatively little is typically known about any given SSD controller, and it's usually impossible to make direct comparisons. But suffice to know that cheaper drives will usually make do with lower-specification controllers. Typically, such controllers will be capable of high theoretical peak speeds, but struggle when it comes to the finer detail of SSD performance. Quoted IOPS performance can be a useful yardstick when comparing drives in that context.

Which brings us very neatly back to that question of SSD performance and, indeed, SSD benchmarking. It turns out that peak sequential performance isn't actually that critical to real-world PC performance. Instead, most storage traffic depends on rapid access to small chunks of data dotted around the drive. That's what makes for a fast and responsive-feeling desktop or laptop PC. The size of these small chunks is dictated by the smallest block sectors of storage, which for modern HDDs and for SSDs is 4KB. Hence the shorthand for this workload is 4K random access.



Above-left: The U.2 interface hasn't caught on in client PCs. Above-right: Remember that motherboard support for the latest SSDs can be critical.

What's more, assessing 4K random performance also involves the question of queue depth. Put simply, queue depth is a measure of the number of simultaneous drive access requests. Because SSDs typically have multiple access channels, they can execute access requests in parallel, and serve up bags of bandwidth. That's quite common for a server PC delivering webpages or database access to scores of clients.

For desktop PCs? Not so much. Instead, it's very low queue depths of one to four that matter, and in those scenarios, an SSD's inherent parallelism counts for a lot less. Long story short, if you're looking for a single metric that gives the best insight into how snappy a given SSD will make your PC feel on a day-to-day basis, it's the 4K random read with a queue depth of one benchmark that you should seek out. Peak sequential performance simply isn't all that.

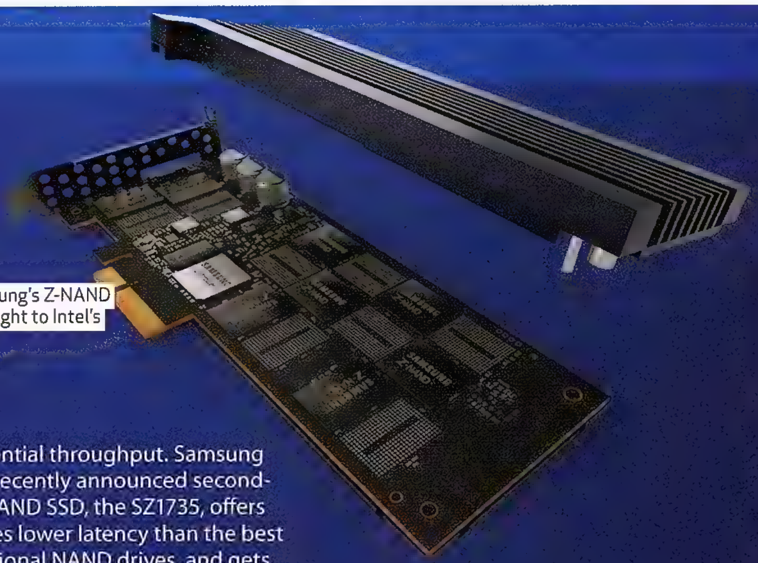
THE FUTURE OF SSDS

Arguably, the future is already here. The two most promising candidates for technology to replace NAND flash as the go-to non-volatile memory technology are thus far Intel's 3D Xpoint (developed with Micron) and Samsung's Z-NAND.

Both are available today in real, buyable SSDs. However, neither has achieved anything like mainstream pricing and they remain largely targeted at high-end commercial applications.

3D Xpoint, which forms the basis of Intel's Optane drives, is a truly revolutionary departure from NAND flash. Instead of creating memory cells out of tiny capacitors as per NAND, 3D Xpoint is a resistance-based technology that uses bulk property change to the cell material to alter its resistance level and so record a memory state.

So, how does Samsung's Z-NAND compare? Like 3D Xpoint, the big selling point is low latency rather than a leap in sequential throughput. Samsung says its recently announced second-gen Z-NAND SSD, the SZ1735, offers five times lower latency than the best conventional NAND drives, and gets within spitting distance of 3D Xpoint. For comparison, Z-NAND is rated at 12–20μs (microseconds) for read latency, while 3D Xpoint achieves 10μs.



Can Samsung's Z-NAND take the fight to Intel's Optane?

How does Z-NAND do it? Samsung is keeping quiet. It's known to be a derivative of SLC NAND, perhaps with shorter bitlines and wordlines. With so little to go on, it's hard to be sure how the competition will play out. It's not even clear the extent to which Z-NAND is a proprietary tech based on intellectual property that can't legally be copied.

That's the greatest worry regarding 3D Xpoint – that Intel will slow-ball development if it ever gains a significant advantage. But even if Z-NAND does end up being a Samsung-only tech, Samsung versus Intel will drive the industry forward faster than just one of them dominating the market for next-gen non-volatile memory, that's for sure. ■

SMART STYLE: NEXT-GEN SMARTWATCHES
AUSTRALIAN
T3
SMARTER LIVING
HOME CINEMA HEAVEN
Jaw-dropping HDR TVs and Dolby Atmos speakers for every budget
HANDS-ON
Samsung 8K TV
COMPLETE GUIDE TO DRONES
FLIGHT, CAMERA, ACTION!
FUTURE
POWERFUL 2-IN-1 LAPTOPS
Super-flexible, pro-level specs
HOT!
AI smart speakers
YOUR PERSONAL ASSISTANT ALSO PLAYS MUSIC!
SUMMER ISLAND ESCAPES
Best noise cancelling headphones for getting there

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System News

Mark Williams RAMs home the idea that DDR prices will be falling, soon.

The price of DRAM was at record highs through 2018, making it tough – especially at the beginning of that year – to recommend higher system memory capacities in some situations. You know it's rough when the recommended amount of RAM you desire costs more than what many high-end consumer CPUs go for!

DRAM prices peaked earlier last year when Samsung and Micron both reported that the migration to their new 18nm and 17nm production nodes respectively were facing teething problems with respect to sampling and yields. With the PC market booming, SK Hynix, the only other major memory manufacturer (95% market share between all three), while not transitioning to a smaller node, wasn't able to pick up the huge amount of slack left by Samsung and Micron causing a memory shortage in the market. Once the manufacturing issues were resolved just before mid-year memory prices started to fall once again.

Underlying all of thgat were fresh allegations of price fixing made by Wu Zhenguo, head of China's anti-monopoly bureau under the State Administration for Market Regulation who said, "The anti-monopoly investigation into these three companies has made important progress… [it] has yielded massive evidence".

Quite what that evidence is remains unclear, as nothing further has been revealed from the investigation at the time of writing; however, this isn't the first time these companies have been caught price-fixing. It has happened twice before, in 2005 by the US Justice department and again in 2010 by the EU Commission. If this is found to be the case again, there's no doubt that it would help explain why DRAM prices have remained largely flat (ignoring the supply shortage spike) for well over a year.

RAMeXchange, which is known to be a reliable source for DRAM price change news, has stated that it expects to see an around 10% decrease in DRAM production contract prices by the end of 2018 and a greater than 10% reduction in prices by the end of Q1 2019. This is in part due to some contracts being revised downwards twice in November, something that very rarely happens, showing a pessimistic outlook for the market.

With supply finally starting to outstrip demand thanks to increased yields of the new manufacturing node processes at Samsung and Micron and DRAM contracts currently now being made on short term monthly cycles, there's every chance that DRAM prices will come down quite substantially over the first half of 2019. Especially for 32GB kits, which manufacturers have begun offering attractive prices on to drive sales.

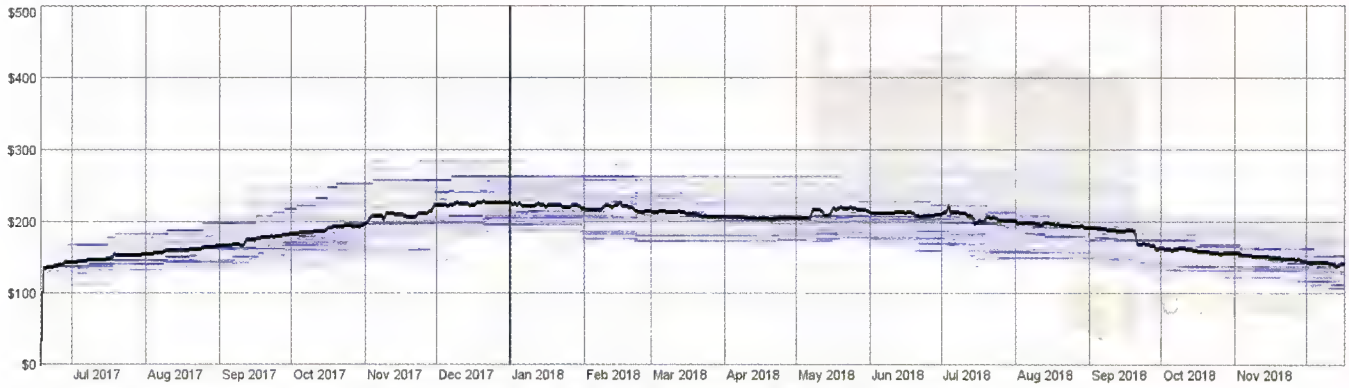
As John from TI Computers also points out, Intel's ongoing issues with moving to 10nm, causing a 14nm production backlog and thus an Intel CPU shortage, will "thus reduce the demand for PCs and by extension, DRAM", further easing price pressures.

So, if you're thinking of upgrading your system's RAM or purchasing a new PC, perhaps wait until the end of Q1 or mid-2019 to allow these new contract prices to flow through the supply chain. With any luck you could find some decent savings to put towards other things.

SHOP TALK

How has the DRAM market been of late, any sign of prices wavering or falling? What is your most often sold DRAM speed and capacity for PCs?

John, TI Computers: *"Although the market for DRAM has been holding steadily since the middle of the year, in considering the current market, I predict that the price will drop around 10-20%. One of the reasons, in my opinion, is due to the shortage of CPUs from Intel, thus reducing the demand for PCs and by extension, DRAM. The most popular RAM speed and combined capacity is 16GB DDR4 2666MHz."*



Average RAM Price (USD) Over Last 18 Months (DDR4-2400 288-pin DIMM 4x4GB) -- pcpartpicker.com

Market Snapshot

A sampling of PC systems available this month.

PC Case Gear Valkyrie 2080 Ti Gaming System

$6,599 TINYURL.COM/APC464-PCCG

When the best, and nothing but the best will do, turn to the Valkyrie. This killer machine will put many workstation grade systems to shame, in part thanks to the 8-core 16-thread 9900K which clocks up to a dizzying 5GHz. It's great for productivity, not just gaming. The graphics card is capable of pumping out games at 4K resolutions with drool worthy ray-tracing and all details and effects turned up high, all at a smooth 60fps+. Copious amounts of storage and RAM with a powerful PSU put this into the best of the best category. Oh, and of course, it has RGB lighting everywhere!

KEY SPECS: CPU: Intel Core i9 9900K; Cooler: NZXT Kraken X62 280mm; Motherboard: Gigabyte Z390 Aorus Extreme; Graphics: Gigabyte Aorus GeForce RTX 2080 Ti
Memory: Corsair Vengeance RGB Pro 32GB DDR4 3000MHz; Storage: Samsung 970 PRO NVMe SSD 512GB, Samsung 860 EVO SSD 1TB, Seagate Barracuda 2TB HDD; Power Supply: Phanteks Revolt X 1000W; Case: Phanteks Enthoo Evolv X DRGB

JW Computers P1000-i8700

$1,149 TINYURL.COM/APC464-JW

This PC is a little lopsided. It has the second fastest CPU in the 8th gen Intel line-up, but it doesn't have the RAM speed or capacity to feed it properly under heavy loads, with the same going for the SSD. Certainly not what a typical power user who would utilise such a processor would typically want. The motherboard is OK but is missing USB3.1 Gen2 support and doesn't have any HDMI or DisplayPort connectors, only a DVI-D and VGA. We'd highly recommend upgrading to 16GB at checkout to at least give the power user it goes to the ability to multitask efficiently.

KEY SPECS: CPU: Intel Core i7-8700; Cooler: OEM; Motherboard: Asus H310M-K; Graphics: Onboard; Memory: 8GB DDR4 2133Mhz; Storage: 240GB SATA SSD; Power Supply: Tsunami 600W; Case: Tsunami P43

Scorptec Hornet Core i7 Pro Office PC

$1,399 TINYURL.COM/APC464-SCORP

Aimed at office use, this PC is on the upper end of what one would typically require for an office PC, but perhaps you're not any ordinary worker and need some extra grunt and speed to crunch through that data your boss wanted yesterday. The 6-core 12-thread processor clocks high and with the 16GB of RAM it will allow you to complete most tasks you can throw at it within good time whilst running multiple other heavy programs at the same time.

The 500GB SSD is very nice in this price bracket but do be mindful that there is no secondary HDD.

KEY SPECS: CPU: Intel Core i7 8700; Cooler: OEM; Motherboard: Asus Prime H310M-E R2.0; Graphics: Onboard; Memory: Crucial CT 16GB 2400MHz DDR4; Storage: Samsung 860 EVO 500GB M.2 SSD; Power Supply: Cooler Master 420W; Case: Cooler Master MasterBox E300L mATX

TI Computers Infinity Gaming 9700K

$2,450 TINYURL.COM/APC464-TI

Are you wanting a perfect PC for gaming at 1440p at 144Hz? This system will suit such a task very well, with the best gaming CPU around matched with the GPU horsepower to achieve it. The well-ventilated case houses a 700W PSU, making it good for multiple upgrade cycles. The motherboard has good IO capabilities and options although it is missing a USB-C connector type, which while still not currently ubiquitous, it will become more prominent as time goes on. The only other thing to be aware of in this quite frankly great system is the SSD. It's only SATA, not NVMe, which is fine, just not quite the best out there.

KEY SPECS: CPU: Intel Core i7-9700K; Cooler: Cooler Master Hyper 212; Motherboard: Asus TUF Z390-Plus Gaming; Graphics: RTX 2070; Memory: 16GB DDR4 2400Mhz; Storage: Kingston 480G SSD; Power Supply: Antec 700W; Case: Cooler Master CM593

PC blueprints

The *APC* team's picks for a part-by-part perfect PC build to suit your budget.

PARTS LIST

PART		PRICE
CASE	BITFENIX NOVA TG	$69
PSU	450W EVGA 450 BT 80+ BRONZE **NEW**	$69
MOBO	ASROCK AB320M-DGS	$75
CPU	AMD RYZEN 3 1200	$145
GPU	GIGABYTE GEFORCE GTX 1050 TI 4GB **NEW**	$239
RAM	8GB (2X 4GB) CORSAIR VENGEANCE LPX @ 3,000MHZ **NEW**	$159
SSD	120GB SANDISK SSD PLUS **NEW**	$32
HDD	1TB SEAGATE ST1000DM010	$65
OS	UBUNTU DESKTOP LINUX 18.04 LTS 64-BIT	$0
APPROXIMATE PRICE:		$859

It's been a long time since we've changed anything dramatic in our budget build, and for good reason: There's nothing right now that would shake up its performance. Everything seems to be situated at the high end. Even Nvidia's RTX 2060 is still waiting in the docks for some meaningful competition, trying to eke out that last cent for folks committed to buying the latest-gen GPUs. That said, we've had a bit of a shuffle around, saved some cash, and managed to splurge on a slightly better GPU: the GTX 1050 Ti. It's not frame-breaker, but it's a darn sight better than the 1050. We're talking a 20 percent improvement on the base hardware alone. Unfortunately, it's not the 80 percent you'd get for going to the 1060 3GB model, but still an improvement nonetheless.

PARTS LIST

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	$129
PSU	550W EVGA SUPERNOVA 550 G3 80+ GOLD	$149
MOBO	ASUS ROG STRIX B450-F GAMING	$209
CPU	AMD RYZEN 7 2700	$379
COOLER	CORSAIR HYDRO H100I PRO 240MM RGB AIO	$160
GPU	MSI GEFORCE GTX 1070 TI GAMING	$649
RAM	16GB (2 X 8GB) G.SKILL RIPJAWSX 2133MHZ	$219
SSD	250GB SAMSUNG 970 EVO M.2 PCIE SSD	$78
HDD	1TB SEAGATE ST1000DM010	$65
OS	WINDOWS 10 HOME 64-BIT OEM	$140
APPROXIMATE PRICE:		$2,177

We desperately wanted to trade out that 1070 Ti for a 1080, but the price difference is nearly double that of the MSI card we are using. "Frustrating" doesn't quite capture the feeling. "Confusing" might be a better word. In our testing, we've found that the 1070 Ti is only around three to five frames per second slower than the 1080. All in all, though, this issue saw no change. Next on the upgrade agenda would be a better-specced motherboard, potentially the Asus Prime X470-Pro. Because it comes in at $289 right now, that's a $80 increase, which would still keep us below our $2,500 budget, but also provide some seriously improved connectivity.

UPGRADE OF THE MONTH

AMD Threadripper 2920X

$1,019, WWW.AMD.COM

We're seriously impressed by AMD's Threadripper lineup, having just about wrapped up our second-generation TR testing. All in all, it's a sound investment for anyone looking to get into video editing, or any similar professional pursuit. The 2920X, in particular, has caught our attention, not only for its price point, but also because of its versatility. Plus, when you look at how far AMD has come in such a short space of time with memory improvements and the plug-and-play nature of its Threadripper lineup, it's hard not to feel admiration. If we were looking to invest in a new rig, the TR 2920X would be our first port of call. With its multicore performance, competitive in-game prowess, incredible temps, and reasonable price, it's an awesome chip. And when paired with a decent cooler, some good memory, and a solid motherboard, it becomes a true monster.

> "Annoyingly, despite the fact we suspect Nvidia and AIBs have excessive levels of GTX 1080 Ti stock, the prices for the cards are sky-high compared to the RTX 2080."

Again, no changes in our Turbo build. Annoyingly, despite the fact we suspect Nvidia and AIBs have excessive levels of GTX 1080 Ti stock, the prices for the cards are sky-high compared to the RTX 2080 right now. Given the two cards are the same, it seems Nvidia is attempting to push the market into its ray-traced field, likely to bolster the attractiveness of its ray-tracing gameworks features to developers, and in turn get more sales of the RTX 2080 Ti, its true money-maker. All speculation, but it seems likely.

Outside of our GPU woes, everything else remains the same. You could save some serious cash by dropping out the 2950X for a 2920X. You'd lose out on four cores, but in game, at least, you'd still be packing some seriously impressive frame rates, and 12 cores aren't to be sniffed at – that's still 24 threads.

We're finally starting to see some serious price drops in the memory department. Good quality kits are falling by $20–$30 at a time, and it's looking good for the foreseeable future, with China threatening class action lawsuits against price fixing. Aside from that, we've kept it all fairly standard. We have heard of our favorite CPU cooler having some faulty review units, so we'd keep an eye on that (perhaps opt for a Corsair or NZXT variant instead, if you are worried), but otherwise we're happy with where this build's at.

PARTS LIST

PART		PRICE
CASE	NZXT H700I	$173
PSU	CORSAIR RM750X MODULAR GOLD	$110
MOBO	ASUS PRIME X399-A	$300
CPU	AMD THREADRIPPER 2950X	$1,415
COOLER	ENERMAX LIQTECH TR4 II 240MM RGB AOI	$140
GPU	GIGABYTE GEFORCE RTX 2080 GAMING OC	$1,199
RAM	32GB (4X 8GB) G.SKILL TRIDENTZ 3200	$519
SSD	512GB SAMSUNG 970 PRO M.2 NVME	$200
HDD	2 X 2TB SEAGATE BARRACUDA ST2000DM006	$160
OS	WINDOWS 10 HOME 64-BIT OEM	$140
APPROXIMATE PRICE:		$4,356

Full HD AMD Gaming Rig

So, this is what happens when Team Red accidentally sends you two RX 590s…

We'll be honest, even if AMD hadn't sent us two cards to test "by accident," we would have probably still had a crack at stacking an RX 590 into our monthly "Build It." It's an interesting release, at least on paper, if only because it doesn't make a whole lot of sense. We gave the RX 580 a lot of flak when it first launched, due to the fact that, spec for spec, it was identical to the RX 480, albeit with a little extra clock speed. Fast-forward another year, and bam! We're witness to a card with the same internal hardware specifications (although, apparently, it's a 12nm card now), and a slightly higher clock speed. This isn't progress, but more on that later….

So, our hatred of obvious rebadges aside, AMD is the name of the game with this build. We do enjoy a bit of the ol' Ryzen love, and as we have a swanky new ROG Strix X470-F Gaming in house, along with a few more budget components, stacking them together seemed like an obvious choice. It's time to produce something positively mid-range, and hopefully 1080p-busting, too. Complete with a 250GB Samsung 860 Evo, a 1TB WD Blue, and 16GB of DDR4, this hex-core system should really deliver in the world of the 1080p gamer.

> "We gave the RX 580 a lot of flak when it first launched, due to the fact that, spec for spec, it was identical to the RX 480, albeit with a little extra clock speed."

COOL WHIP

let's break it down into those sweet components. The big one is the Ryzen 5 2600X. This no-nonsense chip from AMD packs six cores, 12 threads, plenty of cache, a base clock of 3.6GHz, and a boost clock (single-core only) of 4.2GHz. It also comes with a cooler, but we're going with the not-so-low-key Cooler Master MasterAir G100M RGB, because it's relatively affordable, RGB, and looks darn baller.

On top of that, we're packing in two sticks of 8GB G.Skill SniperX 3,200MT/s in urban snow camouflage, so there's no chance anyone will see it storing our volatile information, at least during the winter months in those built-up areas. We've also added a 250GB Samsung 860 Evo SSD and a 1TB Western Digital Blue, to back it up with something a little more concrete. It's the go-to gaming staple now days, but still not something to be sniffed at. 250GB of solid-state flash for the operating system will see our rig performing smoothly, while the additional 1TB of slower spinning platters will keep our game library running nicely. We would see it as a media library, too, but as more of us in the office are turning to streamed sources of both music and films, we do wonder just how accurate a description that is anymore.

The weak link in the chain has to be the case. The BitFenix Enso is a fairly budget ATX tower that has some nice frilly RGB features embedded into the front panel, and the usual plethora of modern-day creature comforts littering the interior, but it has one massive problem: airflow. In short, the entirety of the front panel is solid, from top to bottom. The only air intake at the front is a wedge-shaped cut-out, located below the feet, running up to the front. It's not an intuitive design at all, so you have to either be in a very cool climate, be touting some serious air conditioning, or just not care particularly about thermals.

PARTS LIST

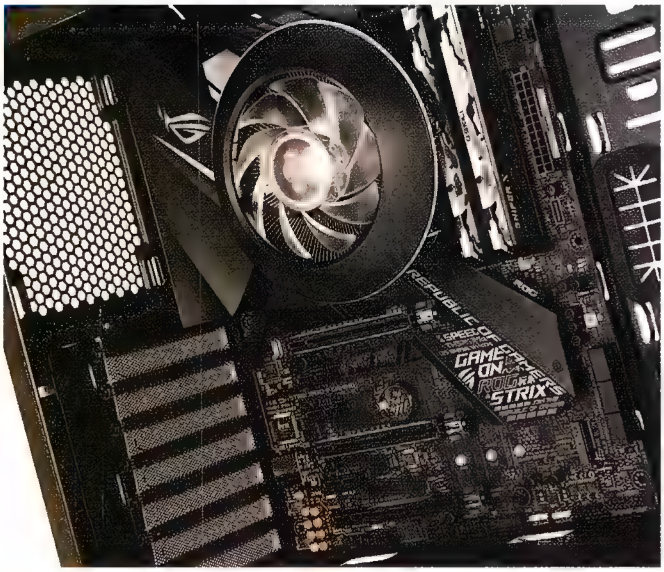
PART		STREET PRICE
CASE	BITFENIX ENSO MID TOWER	$168
MOTHERBOARD	ASUS ROG STRIX X470-F GAMING	$319
CPU	AMD RYZEN 5 2600X	$349
CPU COOLER	COOLER MASTER MASTERAIR G100M RGB	$69
GPU	XFX RADEON RX 590	$429
MEMORY	16GB (2X 8GB) G.SKILL SNIPER X @ 2,400MHZ	$229
PSU	600W BE QUIET! PURE POWER 11 CM GOLD	$109
STORAGE	250GB SAMSUNG 860 EVO 2.5-INCH SSD	$75
STORAGE	1TB WESTERN DIGITAL CAVIAR BLUE 3.5-INCH HDD	$55
OS	WINDOWS 10 HOME 64-BIT	$140
TOTAL		$1,942

1 OUTSIDE THE BOX

We don't always do it ourselves, but if you're building a rig, it's good practice to test the main components outside the chassis first. Use your motherboard box as an antistatic test bench, carefully lay the mobo itself on top, and start installing your hardware. We've taken this opportunity to carefully install our memory, CPU, and cooler first, because it's easier to do this outside the case than in. The MasterAir's a funny old thing; the mounting solution, although secure, is difficult to access. There's a wrench included to turn the top nuts, but we found it far easier to tighten them by hand.

2 NO FERRARI

Our next step was to strip the Enso down as much as we could. This included yanking the rather stubborn front panel off, along with the side panels, before becoming embroiled in a battle with the "Aura Sync" sticker stuck to the side of the PSU shroud. It's all fun and games until it leaves a nasty white residue behind when you remove it, and you spend the next 30 minutes trying to clean it off with lighter fluid and a microfiber cloth. As an aside, we're also hauling that front 120mm fan out of the chassis, and replacing it with two 140mm fans we had lying around, in an attempt to bolster the internal airflow.



3

MOTHERBOARD IN

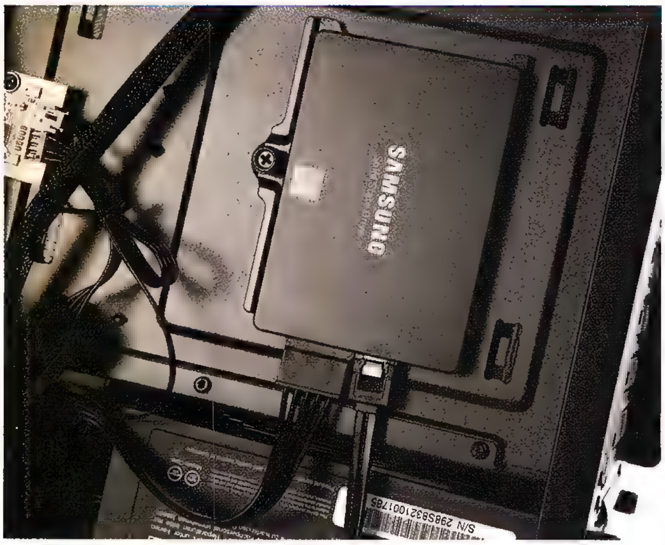
Thankfully, because we've already pre-installed the CPU cooler and RAM, installing the motherboard into the chassis is a relatively painless procedure – just make sure you find the stand-offs, which are hidden in a little clear bag along with the case screws, tied to one of the hard drive caddies, first. Fortunately, the ROG Strix X470-F has its backplate pre-attached to the motherboard, so there's no forgetting that.

4

SHHHH!

Next up on the list is the PSU. In this case, we're running with a 600W Be Quiet! Pure Power 11. This new PSU from the German company is a semi-modular beauty, coming in at an impressively affordable price point. Only downside? The EPS power is a bit short, and the case isn't that great with routing, so we've had to thread the power cable up and through the CPU socket cut-out. To do this, you have to remove the screws that secure the motherboard, run your cable through the cut-out, plug it in, then resecure the motherboard back down. It's a bit tight, but will run absolutely fine.

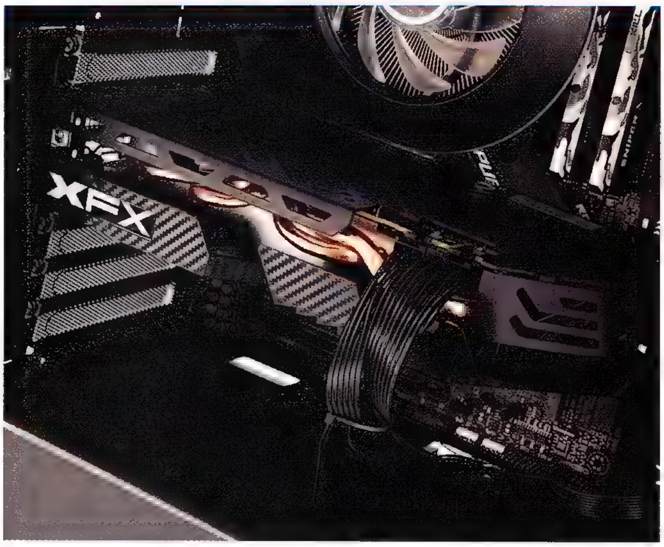
> "It's a beast of a card, and looks absolutely stellar in our system. From the angled GPU block to the carbon fiber and black ventilated backplate, it certainly looks the part."



5

SOLID-STATE SNEAKINESS

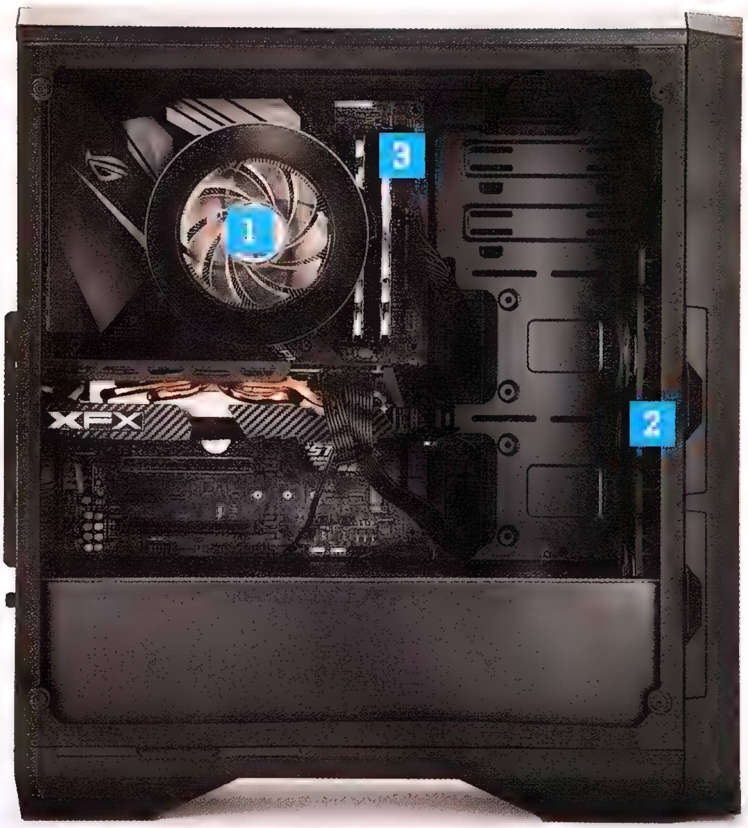
We've also attached our SSD to the back of the motherboard tray, with the included caddy located here. There's only one as standard, but it's a fairly painless experience. It may sound obvious, but make sure you use flat-ended SATA cables for your 2.5-inch devices here. Also worth pointing out is that, although you can technically fit a 2.5-inch HDD or hybrid drive, it's not advisable, because the orientation can lead to additional stress on the drive and more overall noise, due to vibrations against the rear side panel. Instead, use the caddies located in front of the PSU, for 3.5-inch drives.



6

RADEON FOREVER

Last but not least is the centerpiece of our build: the XFX Radeon RX 590. It's a beast of a card, and looks absolutely stellar in our system. From the angled GPU block to the carbon fiber and black ventilated backplate, it certainly looks the part, and is really clean, too. We also took the opportunity to tie the two PCIe power cables together, before cutting the loose end off; because it's all black, it should look fairly inconspicuous, and keep everything tidy and together. The last thing to do is plug in the front I/O headers, and we're good to go.



1 The MasterAir has two connections: one to sync the RGB LEDs with the motherboard, which we've connected at the bottom-left; and another, top-right, for the fan.

2 Three 120mm fans may have been a better solution for front intake, instead of two 140mm; unfortunately, the mounting holes dictate you can only install two 140mm fans, as we've done.

3 Crucial Ballistix memory, or perhaps something a little less camouflaged, may have been a better option for this one.

That's a Wrap

Right, that's our RX 590 build done and dusted. A sub-$2,000 1080p build, with color-coordinated sleekness, tempered glass, and a minimal number of classy RGBs. Is it perfect? No. The case is the weak point, and although the design is fairly understated and classy in contrast to many at this price, the thermal limitation from the front panel leaves a lot to be desired.

Building inside the Enso was painless, though; the only trouble we had was with the sticker on the side of the panel, and trying to find the bag containing the screws and stand-offs. If we were upgrading, it would be one of the first things we'd change, perhaps alongside a better cooling solution.

Overall, performance is where you'd expect. The RX 590, coupled with the 2600X, makes this a prime-time 1080p gaming machine, with most AAA titles easily hitting the high 50s. The Samsung 860 Evo also performs admirably in file transfers, and the Ryzen 5 2600X hammers those Cinebench scores nicely, too, with 1,378 points in multicore, and 173 in single-core.

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	1,152	1,378 (20%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	3,400	542 (-84%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	1,720	514 (-70%)
RISE OF THE TOMB RAIDER (FPS)	60	64 (7%)
TOTAL WAR: WARHAMMER II (FPS)	46	49 (7%)
TOM CLANCY'S GHOST RECON WILDLANDS (AVG FPS)	39	43 (10%)
3DMARK: FIRE STRIKE EXTREME (INDEX)	11,101	11,994 (8%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of an AMD Ryzen 5 1600, 16GB of Crucial Ballistix Sport LT @ 2666, an EVGA GeForce GTX 1060 3GB, and a 250GB Samsung 960 Evo M.2 PCIe SSD. All tests were performed at 1440p at the highest graphical profile.

One of AMD's marketing pitches for the RX 590 was that over 64 percent of the PC gaming audience still plays games at 1080p. The RX 590, then, would be perfect for them, as it performs very strongly at this resolution. (And let's confirm here: it is not a 1440p card, but a 1080p card.) The problem with that is that, yeah, 64 percent may play games at 1080p, but they likely already have a card that's capable of driving games at 1080p. After all, it's not a new resolution, by any means, and there have been cards available for a number of years that are more than capable of driving all of today's titles at that resolution. So, why develop another rehash of a rehash to target a market that is already satisfied with the GPUs they have, and is not even mind-blowing from a price perspective?

The worst part is, it's not as though cryptocurrency is going to pick up the slack now either. With that market seemingly dead, and it being rumored that even Nvidia is going to need two years to shift the remainder of its GTX 1060 stock, well, you get the picture.

All in all, this rig is a fantastic entry point into the mid-range 1080p gaming ecosystem. And don't get us wrong – if you're moving up to that resolution, or haven't had the chance or the coin in the last few years to jump on to a modern GPU, the RX 590 is a good card to go for. But to design an entirely new product off 1080p just seems foolish. ■

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

PRIVACY

REMOVE SENSITIVE FILES FROM HARD DRIVE

I'm a bit paranoid and have some private files I need to delete beyond all trace of recovery. What do you recommend?
David Johnstone

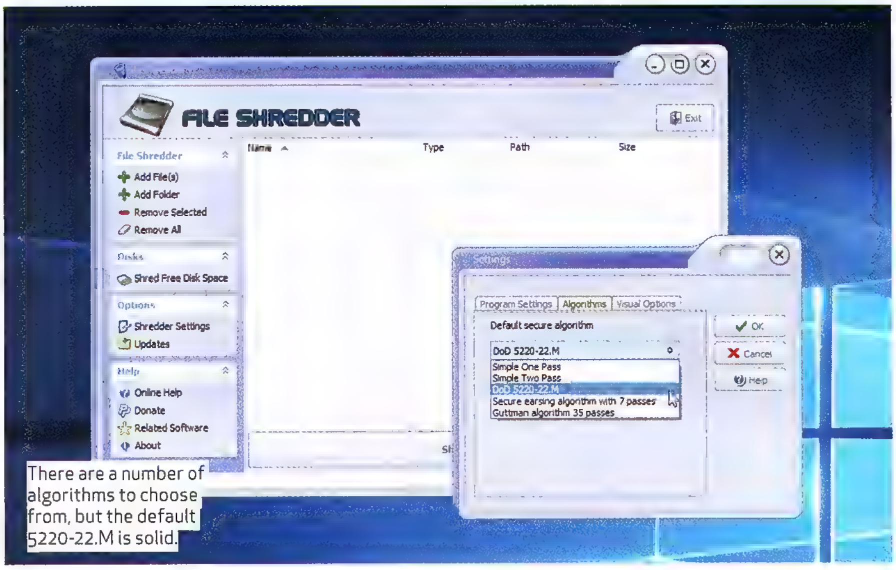
There are several free tools available that can securely wipe all traces of files from your hard drive. One of our favourites – even though it's now been discontinued – is File Shredder. You'll discover how to use in the step-by-step guide right here – happy shredding!

Download and install File Shredder from **www.fileshredder.org** (it's no longer supported, but works fine). Once installed, launch the program and click Add File(s) or Add Folder(s) to select the files and folders you wish scrubbed from your drive.

The default secure algorithm – DoD 5220-22.M – is a good choice, but if you want to change it, go to Shredder Settings and then select the Algorithms tab. Avoid the simple one- or two-pass options – any of the others are adequate alternatives.

Choose your file or folder from the dialog box, then keep adding files and folders as necessary. Select an item from the list and click Remove Selected if you added it by mistake. Click 'Shred Files Now', review your choices and then click OK.

You can completely remove traces of previously deleted files by clicking Shred Free Disk Space. Tick the drive(s) to wipe, choose your default algorithm and click Next > Start. The process can take quite some time, so be patient. It'll be worth it in the end.
Rob Mead-Green



Default secure algorithm: DoD 5220-22.M

Simple One Pass
Simple Two Pass
DoD 5220-22.M
Secure earsing algorithm with 7 passes
Guttman algorithm 35 passes

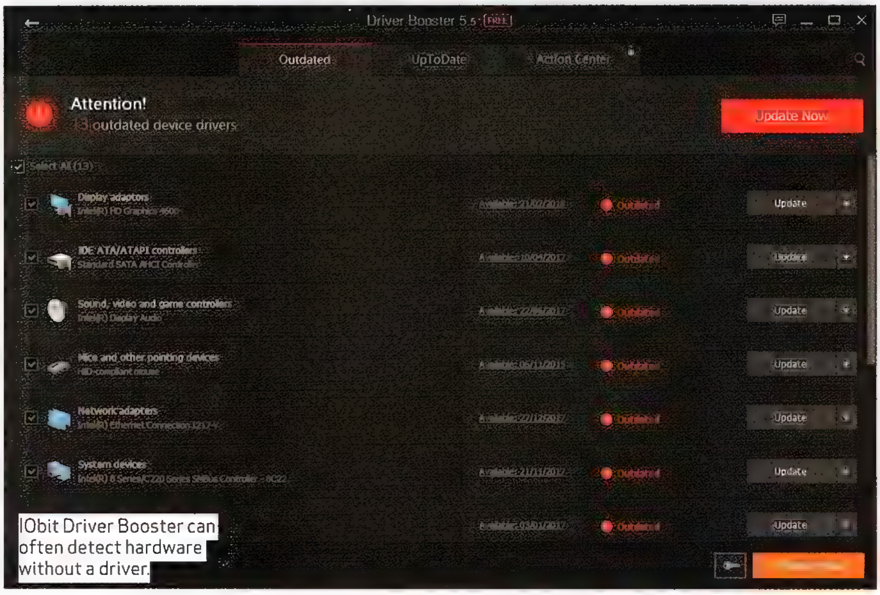
There are a number of algorithms to choose from, but the default 5220-22.M is solid.

HARDWARE

HOW TO IDENTIFY UNKNOWN HARDWARE

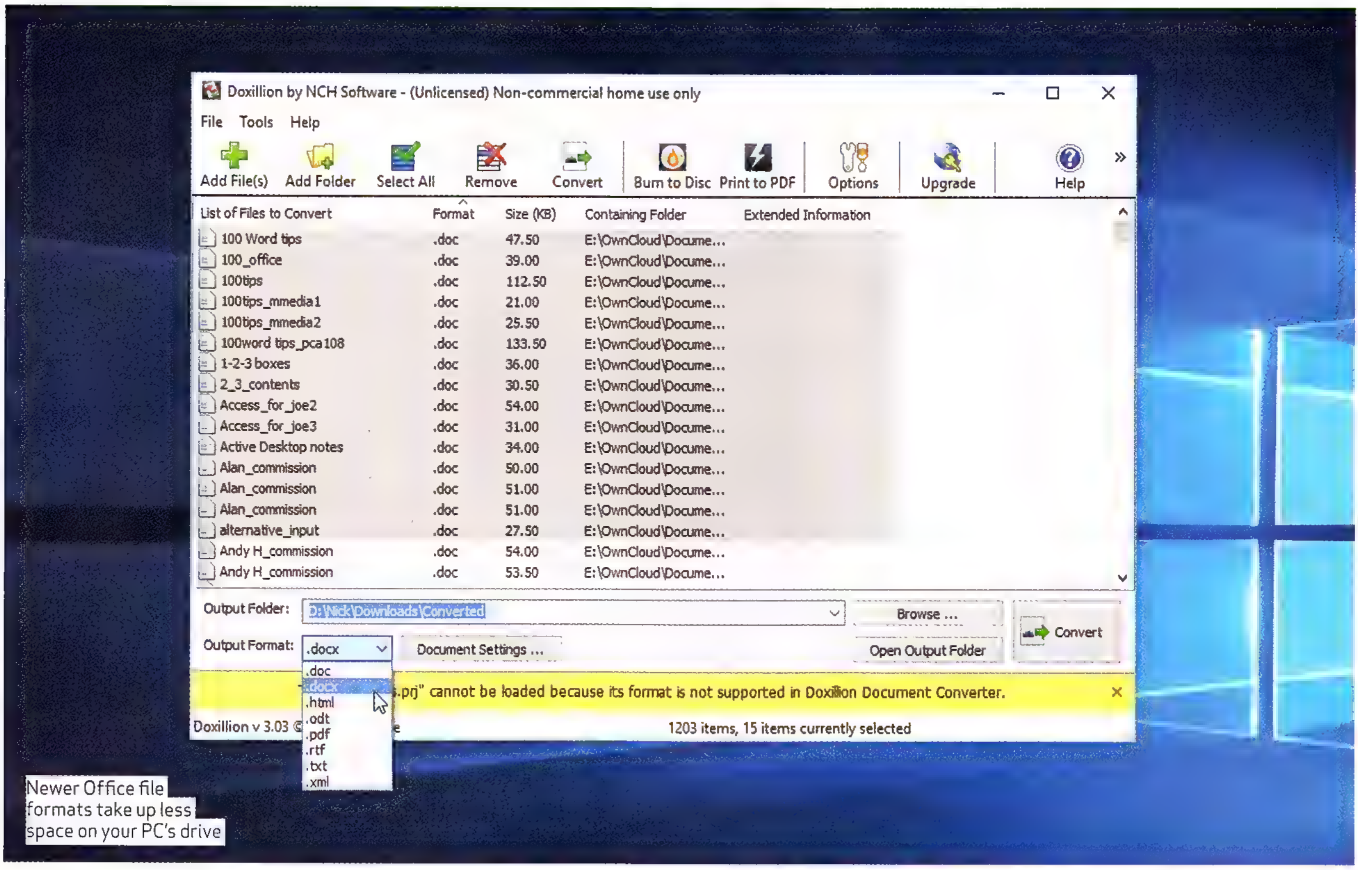
I've installed Windows 10 from scratch, but it can no longer recognise my soundcard. How do I go about tracking down the drivers that I need?
Ellis George

If your PC was an off-the-shelf model, start by visiting its support website to see if drivers are available for Windows 10; if not, try downloading the latest version (Windows Vista or later) that may work if the system type – 32-bit or 64-bit – matches. A similar path should be followed to the motherboard manufacturer's website if you know what make and model of motherboard it has (open it up to find out if necessary). If this doesn't work, then one of a number of tools may help. Try a driver-updating tool like IObit Driver Booster (**www.iobit.com/driver-booster.php**), which may be able to detect – then download and install – what's needed. Failing that Unknown Device Identifier (**www.zhangduo.com/udi.html**) may be able to help you identify the troublesome component and start you on the road to a solution.
Rob Mead-Green



Attention!
13 outdated device drivers

IObit Driver Booster can often detect hardware without a driver.



Doxillion by NCH Software - (Unlicensed) Non-commercial home use only

List of Files to Convert	Format	Size (KB)	Containing Folder	Extended Information
100 Word tips	.doc	47.50	E:\OwnCloud\Docume...	
100_office	.doc	39.00	E:\OwnCloud\Docume...	
100tips	.doc	112.50	E:\OwnCloud\Docume...	
100tips_mmedia1	.doc	21.00	E:\OwnCloud\Docume...	
100tips_mmedia2	.doc	25.50	E:\OwnCloud\Docume...	
100word tips_pca108	.doc	133.50	E:\OwnCloud\Docume...	
1-2-3 boxes	.doc	36.00	E:\OwnCloud\Docume...	
2_3_contents	.doc	30.50	E:\OwnCloud\Docume...	
Access_for_joe2	.doc	54.00	E:\OwnCloud\Docume...	
Access_for_joe3	.doc	31.00	E:\OwnCloud\Docume...	
Active Desktop notes	.doc	34.00	E:\OwnCloud\Docume...	
Alan_commission	.doc	50.00	E:\OwnCloud\Docume...	
Alan_commission	.doc	51.00	E:\OwnCloud\Docume...	
Alan_commission	.doc	51.00	E:\OwnCloud\Docume...	
alternative_input	.doc	27.50	E:\OwnCloud\Docume...	
Andy H_commission	.doc	54.00	E:\OwnCloud\Docume...	
Andy H_commission	.doc	53.50	E:\OwnCloud\Docume...	

Output Folder: D:\Nick\Downloads\Converted

Output Format: .docx

.prj" cannot be loaded because its format is not supported in Doxillion Document Converter.

Doxillion v 3.03 ©

1203 items, 15 items currently selected

Newer Office file formats take up less space on your PC's drive

OFFICE

HOW DO I CONVERT OFFICE FILES QUICKLY?

I have loads of Office files in the old formats – DOC, XLS, PPT and so on – and would like to convert them into the latest Office formats. Is there a quick way for me to do this?

John Wear

Ideally, you'd do this one document at a time, to check the results and enter any additional required information, such as a password. At the very least, don't delete the original files until you've checked the new versions. Converting Word documents can be done with the free version of Doxillion Converter (**www.nchsoftware.com/documentconvert/**), which supports a wide range of text formats including RTF, TXT and ODF (LibreOffice Writer) as well as DOC and DOCX.

Other formats – Excel and PowerPoint – will require different tools, neither of which are free. Visit **www.batchwork.com** for free seven-day trials of XLS to XLSX (Excel) and PPT to PPTX (PowerPoint).

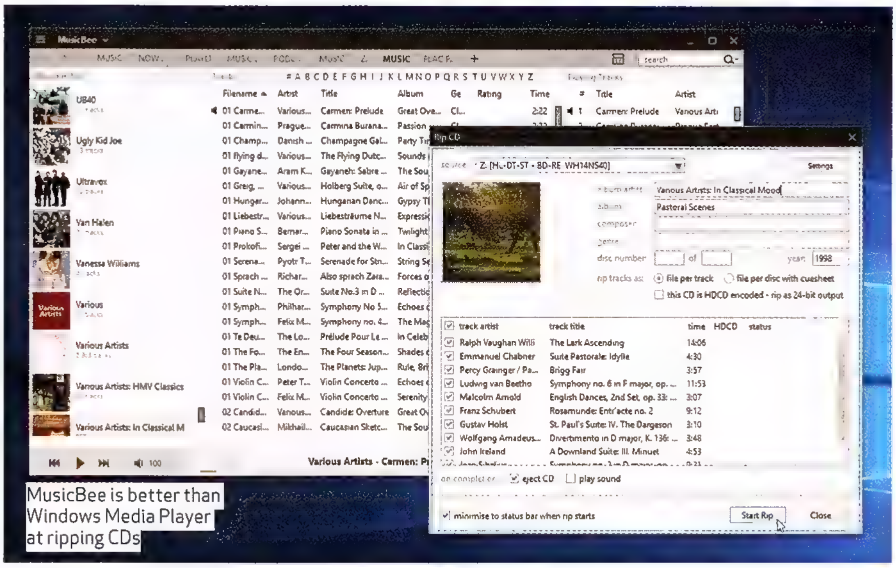
Iain Sleightholm

MEDIA

WINDOWS MEDIA PLAYER HAS BEEN HOBBLED

I rip my music CDs for my personal use, and since the 1803 Windows update in April, Windows Media Player throws up a "webpage cannot be found" error when I attempt to find information for more obscure albums. It continues to work fine on my Windows 7 laptop. Is there a remedy for this?

Malcolm Shore



source: Z: [HL-DT-ST - BD-RE WH14NS40]

album artist: Various Artists: In Classical Mood

album: Pastoral Scenes

composer:

genre:

disc number: of

year: 1998

rip tracks as: ● file per track ○ file per disc with cuesheet

☐ this CD is HDCD encoded - rip as 24-bit output

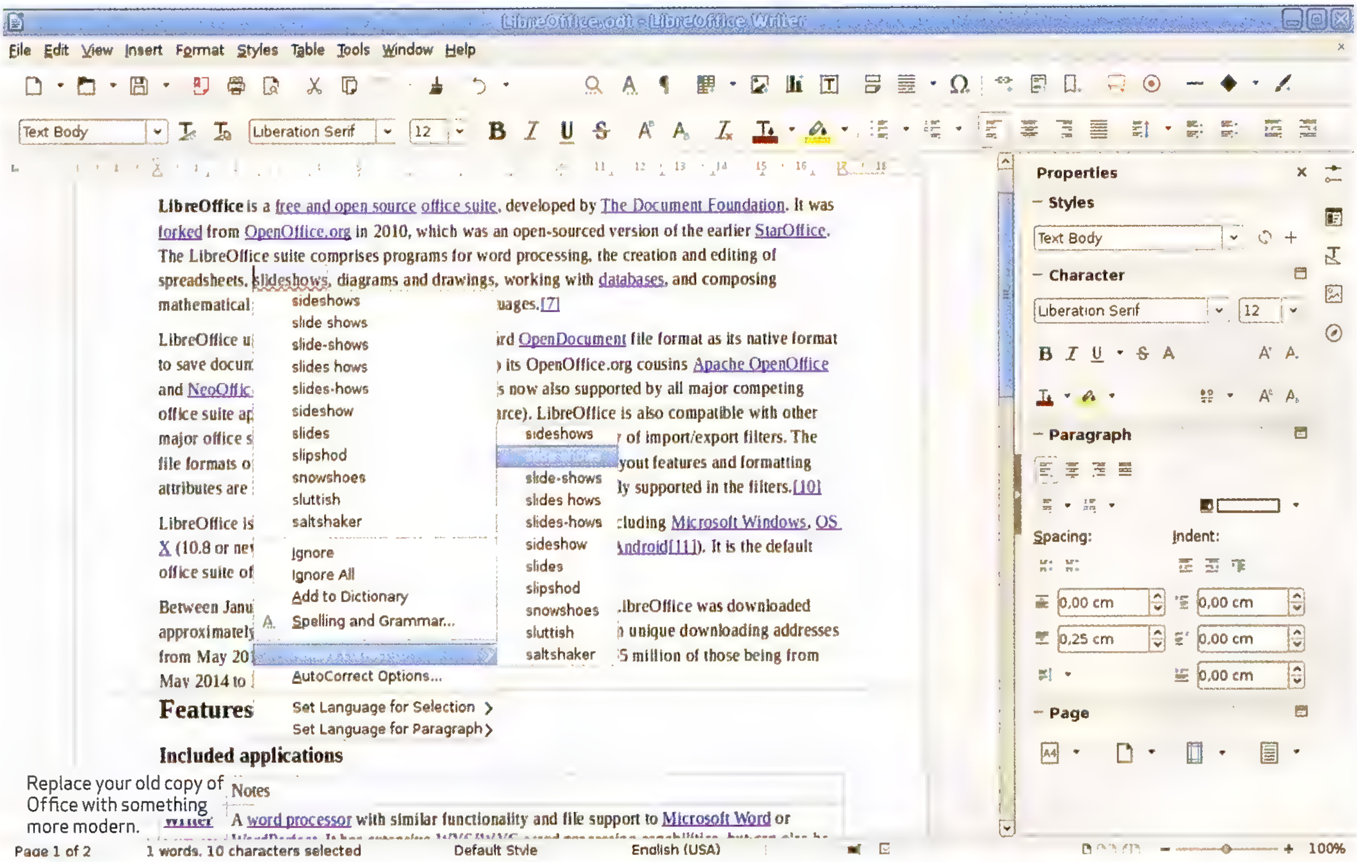
☑ track artist	track title	time	HDCD	status
☑ Ralph Vaughan Willi	The Lark Ascending	14:06		
☑ Emmanuel Chabner	Suite Pastorale: Idylle	4:30		
☑ Percy Grainger / Pa...	Brigg Fair	3:57		
☑ Ludwig van Beetho	Symphony no. 6 in F major, op. ...	11:53		
☑ Malcolm Arnold	English Dances, 2nd Set, op. 33: ...	3:07		
☑ Franz Schubert	Rosamunde: Entr'acte no. 2	9:12		
☑ Gustav Holst	St. Paul's Suite: IV. The Dargason	3:10		
☑ Wolfgang Amadeus...	Divertimento in D major, K. 136: ...	3:48		
☑ John Ireland	A Downland Suite: III. Minuet	4:53		

on completion: ☑ eject CD ☐ play sound

☑ minimise to status bar when rip starts

MusicBee is better than Windows Media Player at ripping CDs

Malcolm had already noted that Windows Media Player has changed the site used to obtain music metadata to **fai.music.metaservices.microsoft.com**. It may well be that the problem is fixed in a subsequent update, but Microsoft is deprecating Windows Media Player over time, and so now might be the moment to source a more modern alternative. Our preferred choice is the brilliant – and free – MusicBee, which is a lightweight but powerful alternative to Windows Media Player. MusicBee is available to download either from the Microsoft Store or **https://getmusicbee.com**. Even if you plan to keep using Windows Media Player as your music player, you can use MusicBee exclusively to rip CDs – press [Alt] + [R] to bring up the Rip CD dialog. Click 'Settings' to verify which format to rip to (MusicBee supports WMA, MP3, AAC and others) and where to store your music before verifying the information and clicking Start Rip. Press [Ctrl] + [O] to open Preferences and select Tags (2) to see which databases MusicBee searches



LibreOffice is a free and open source office suite, developed by The Document Foundation. It was forked from OpenOffice.org in 2010, which was an open-sourced version of the earlier StarOffice. The LibreOffice suite comprises programs for word processing, the creation and editing of spreadsheets, slideshows, diagrams and drawings, working with databases, and composing mathematical … uages.[7]

LibreOffice u… …rd OpenDocument file format as its native format to save docum… …) its OpenOffice.org cousins Apache OpenOffice and NeoOffic… …s now also supported by all major competing office suite ap… …rce). LibreOffice is also compatible with other major office s… …of import/export filters. The file formats o… …yout features and formatting attributes are … …ly supported in the filters.[10]

LibreOffice is … …cluding Microsoft Windows, OS X (10.8 or nev… …Android[11]). It is the default office suite of …

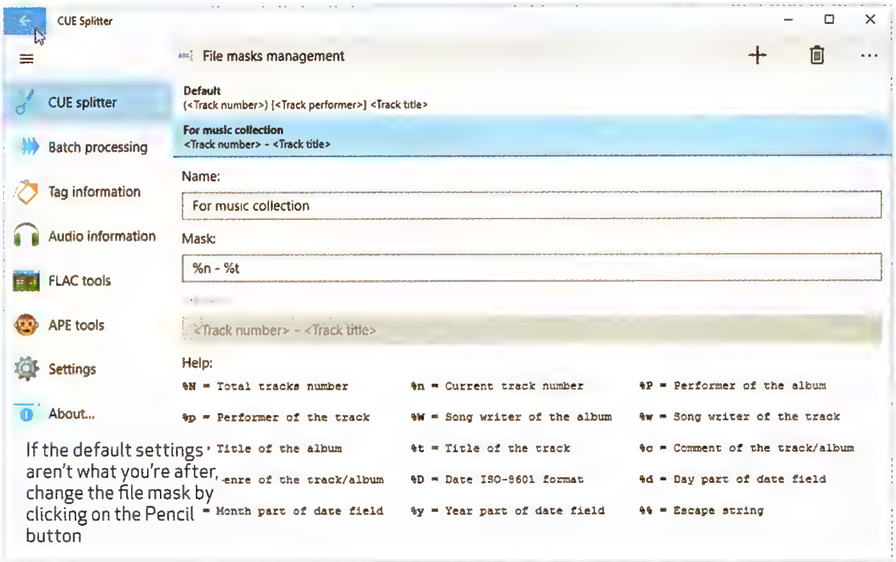
Between Janu… …LibreOffice was downloaded approximately … …n unique downloading addresses from May 20… …5 million of those being from May 2014 to …

Features

Included applications

Notes: A word processor with similar functionality and file support to Microsoft Word or

Replace your old copy of Office with something more modern.



Default
(<Track number>) [<Track performer>] <Track title>

For music collection
<Track number> - <Track title>

Name: For music collection

Mask: %n - %t

<Track number> - <Track title>

Help:

```
%N = Total tracks number       %n = Current track number    %P = Performer of the album
%p = Performer of the track    %W = Song writer of the album  %w = Song writer of the track
     Title of the album        %t = Title of the track      %c = Comment of the track/album
     enre of the track/album   %D = Date ISO-8601 format    %d = Day part of date field
   = Month part of date field  %y = Year part of date field  %% = Escape string
```

If the default settings aren't what you're after, change the file mask by clicking on the Pencil button

freeDB and last.fm by default) by default. Click the ellipsis (...) to add Gracenote – other providers can be added as plugins (for example, Discogs – **https://getmusicbee.com/addons/plugins/13/discogs-tagger/**).

Rob Mead-Green

APPLICATIONS

EXCEL COMPATIBILITY WITH SPRING UPDATE

I have a very old version of Microsoft Office that I use principally for Excel and Word. Since the Spring Windows update, when I start working on them they close without warning, making it impossible to work with them. If I revert back to before the update, they're fine, so I know it's the update causing the problem. Do you have any suggestions for how to overcome it?

Colin Travis

Colin wasn't sure if he was running Office 2002 or Office 97, but in either event, it's a miracle they've worked for so long since neither is officially supported in Windows 10. With that in mind, a fix is out of the question. Thankfully, free Office alternatives are widely available, all of which should have no problems handling Colin's older Office file formats. If you want a full office suite with a familiar menu-based interface, then try LibreOffice (**www.libreoffice.org**), or there's FreeOffice 2018 (**www.freeoffice.com/en**), which offers alternatives to Word, Excel and PowerPoint and a modern Ribbon interface. Either will work fine – you can install both alongside your existing version of Office to test them, then stick with the program you prefer.

Nick Peers

MEDIA

HOW TO SPLIT A SINGLE MUSIC FILE INTO SEPARATE TRACKS

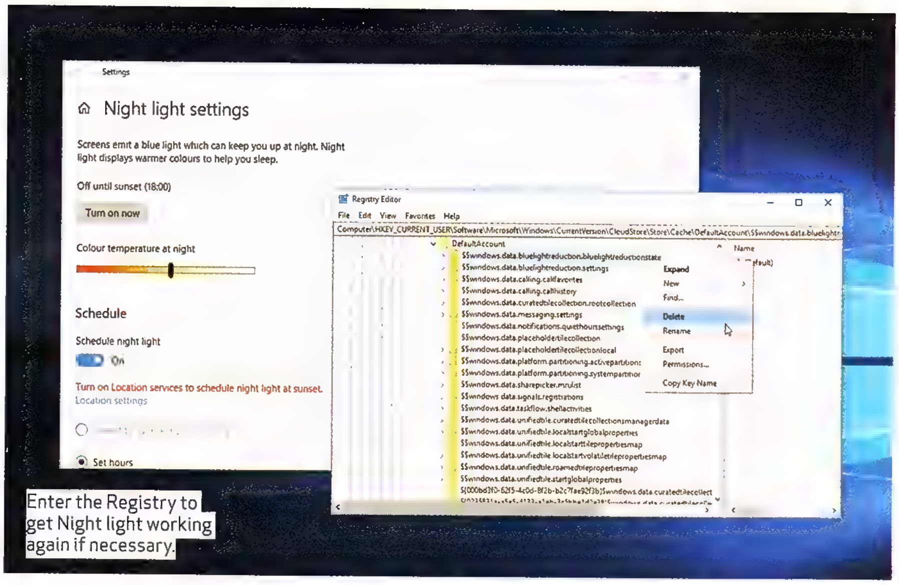
I've been given a music album as a single file rather than as individual tracks. Is there a way to split this into the separate songs?

Jan Powell

If you can track down a CUE file for the album (it may have been supplied with it, or try searching **www.regeert.nl/cuesheet/**) then armed with the right tool, you can use this file to quickly and easily split the album as required.

Our free tool of choice is CUE Splitter. Go to **www.medieval.it/cuesplitter-pc/** – if you're running Windows 10 then choose the UWP version (which we are featuring here); if you're running Windows 8.1 and earlier, choose the older PC version.

Launch CUE Splitter and click the Open button. Select your CUE sheet – which should be in the same folder as the audio file – and click Open. A list should appear. Either click the Scissors button to split all tracks, or the menu



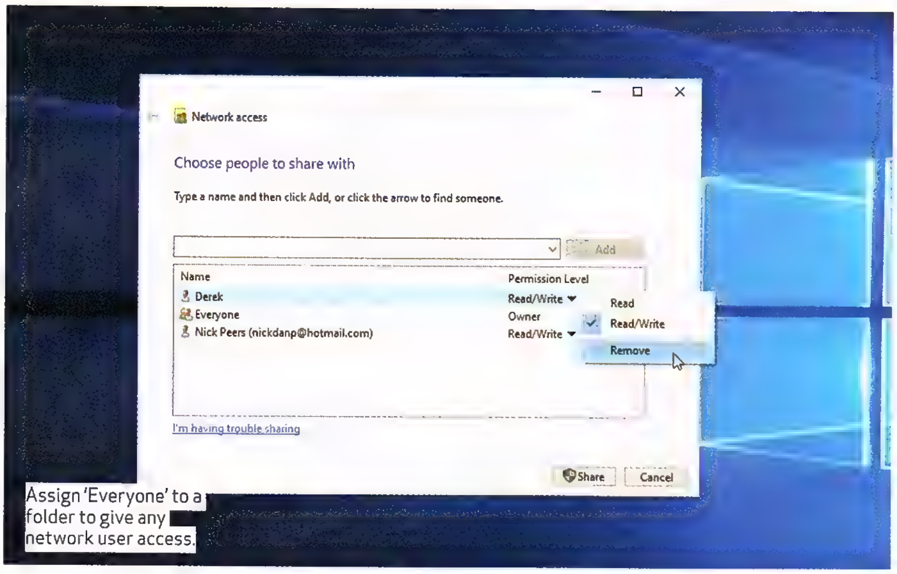
Screens emit a blue light which can keep you up at night. Night light displays warmer colours to help you sleep.

Off until sunset (18:00)

Turn on Location services to schedule night light at sunset.

```
Computer\HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\CloudStore\Store\Cache\DefaultAccount\$$windows.data.bluelight
$$windows.data.bluelightreduction.bluelightreductionstate
$$windows.data.bluelightreduction.settings
$$windows.data.calling.callfavorites
$$windows.data.calling.callhistory
$$windows.data.curatedtilecollection.rootcollection
$$windows.data.messaging.settings
$$windows.data.notifications.quiethourssettings
$$windows.data.placeholdertilecollection
$$windows.data.placeholdertilecollectionlocal
$$windows.data.platform.partitioning.activepartitions
$$windows.data.platform.partitioning.systempartitior
$$windows.data.sharepicker.mrulist
$$windows.data.signals.registrations
$$windows.data.taskflow.shellactivities
$$windows.data.unifiedtile.curatedtilecollectionsmanagerdata
$$windows.data.unifiedtile.localstartglobalproperties
$$windows.data.unifiedtile.localstarttilepropertiesmap
$$windows.data.unifiedtile.localstartvolatiletilepropertiesmap
$$windows.data.unifiedtile.roamedtilepropertiesmap
$$windows.data.unifiedtile.startglobalproperties
${000bd3f0-62f5-4c0d-8f2b-b2c7fae92f3b}$windows.data.curatedtilecollect
```

Enter the Registry to get Night light working again if necessary.



Choose people to share with

Type a name and then click Add, or click the arrow to find someone.

Name	Permission Level
Derek	Read/Write
Everyone	Owner
Nick Peers (nickdanp@hotmail.com)	Read/Write

Assign 'Everyone' to a folder to give any network user access.

button to select.

Review the default options – General can be left alone, but you may wish to change the file mask. Click the Pencil button to create a new template – click '+' to create your chosen mask using the tools provided. Click the Back button next to the app title.

Make sure your new file mask is selected from the drop-down menu and then click the Scissors button to select the folder to store your split tracks in. Click 'Select Folder' and the album tracks will be swiftly split into separate files.

Cat Ellis

WINDOWS

NO NIGHT LIGHT

I often use my laptop late at night, and the 'Night light' feature has helped me sleep better afterwards. Problem is, the feature has been disabled and I can't seem to switch it back on. Can you help?

Hannah Lillis

Ordinarily you can enable Night light from the Action Centre or by navigating to Settings > System > Display, but if these options are greyed out for some reason you'll need to enter the Registry to fix the problem. Press Win-R, type regedit and click OK. Navigate to the following Registry key in the left-hand pane:

```
HKEY_CURRENT_USER\Software\
Microsoft\Windows\
CurrentVersion\CloudStore\
Store\Cache\DefaultAccount
```

Expand 'DefaultAccount' and then right-click and delete the following subkeys in turn:

```
$$windows.data.
bluelightreduction.
bluelightreductionstate
$$windows.data.
bluelightreduction.settings
```

Close the Registry Editor and reboot – Night light should now be available once again.

Nick Peers

NETWORKING

CAN'T CONNECT TO SHARED FOLDERS

Windows 10 keeps resetting my network settings, switching on password-protected sharing and making it impossible for me to access shared folders on either of my two PCs until the feature is switched back off. But now it refuses to let me connect without network credentials, despite the fact that neither of my main user accounts are password-protected! Please help!

Les Higgins

In an ideal world, Les would be logging into Windows with a Microsoft account on both PCs, meaning the problem would not arise. However, he's using local user accounts, but because they have the same username all he needs to do is password-protect both accounts using the same password. On doing this, Les reported he was immediately able to access most of his shared folders again. Other shared folders are made accessible by right-clicking the troublesome folder and choosing 'Give access to' > 'Specific people'. Type Everyone into the box and click Add. Click 'Read' under Permission Level and change it to Read/Write before clicking Share and that folder should now be accessible, too. To save the bother of having to log into Windows at startup, press Win-R, type netplwiz and press Enter. Untick 'Users must enter a username and password to use this computer'. Click 'Apply', then enter your user password twice before clicking OK twice. Reboot and you should now boot straight back to the Windows desktop.

Nate Drake

INTERNET

ADOBE FLASH ALTERNATIVE

I've discovered that Adobe Flash has security flaws and that it's also being phased out by 2020. What alternative software would you recommend for Firefox Quantum, Vivaldi and Internet Explorer 11?

Steve Francis

There's no alternative to Flash per se, Steve. But that's because web video is transitioning from proprietary (and flawed) standards like Flash to open and native technologies like HTML5, support for which is baked into all modern browsers. These days, most websites offer HTML5 support in addition to – or even in place of – traditional Flash support.

We'd recommend removing all traces of Flash from your PC, then seeing which websites will require it. Contact them and request support for HTML5 or, if necessary, reinstall Flash but only on a single browser you use to exclusively access that site going forward.

Rob Mead-Green ■

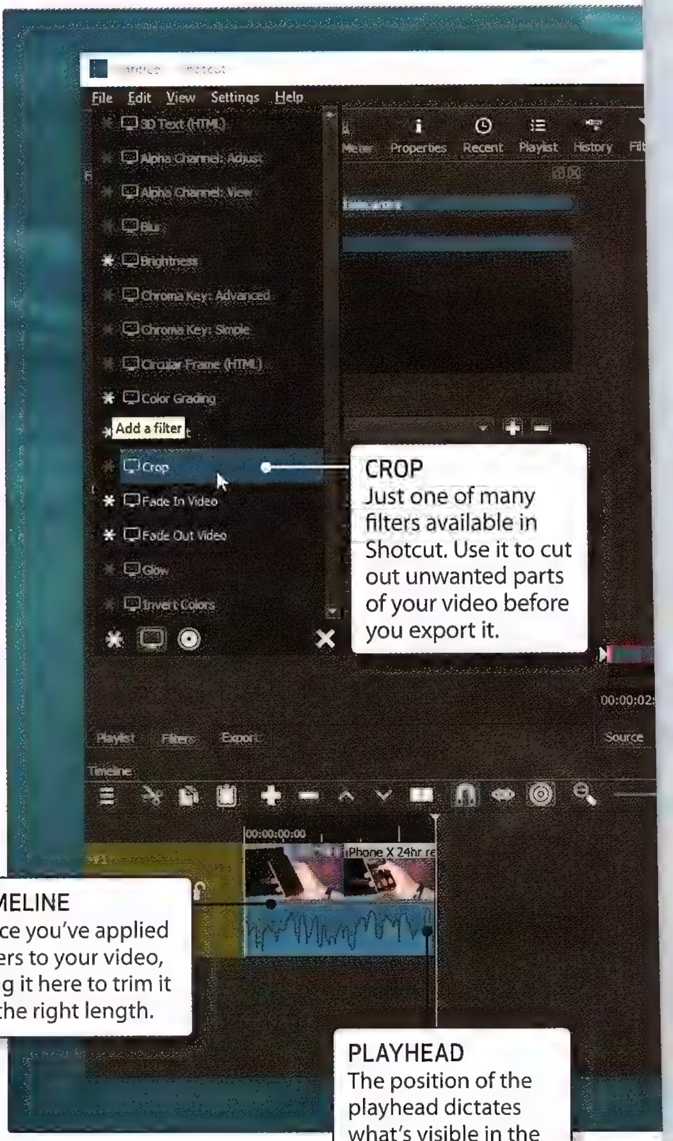
Create a GIF from any video

In this tutorial **Cat Ellis** shows you how to turn any video into a fun animation you can share online.

They say a picture is worth a thousands words, but an animated GIF is worth a million. Despite the rise of HTML5 video, these little animations are still hugely popular – partly because of their relatively small file size, which is friendly to mobile devices on limited data plans, and also because the format is so widely supported.

Sites such as Giphy (**https://giphy.com**) are a great source of ready-made animations, but sometimes you can only express yourself by creating your own – and with the right tools, it's surprisingly easy to do.

If you already have a video file, skip straight to Step 5 to find out how to edit and convert it. Alternatively, you can grab and convert a video from YouTube, as explained in Step 1, or make a recording from your desktop, as described in Step 3. This is a great way to make a GIF from a game or movie playing on your PC.

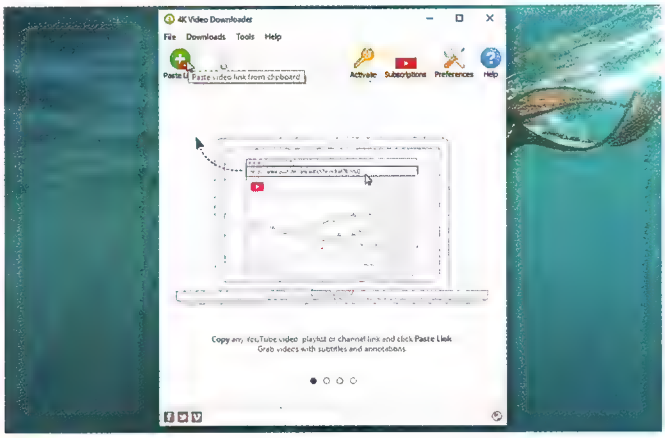


CROP
Just one of many filters available in Shotcut. Use it to cut out unwanted parts of your video before you export it.

TIMELINE
Once you've applied filters to your video, drag it here to trim it to the right length.

PLAYHEAD
The position of the playhead dictates what's visible in the preview. You can also use it to select start and end points.

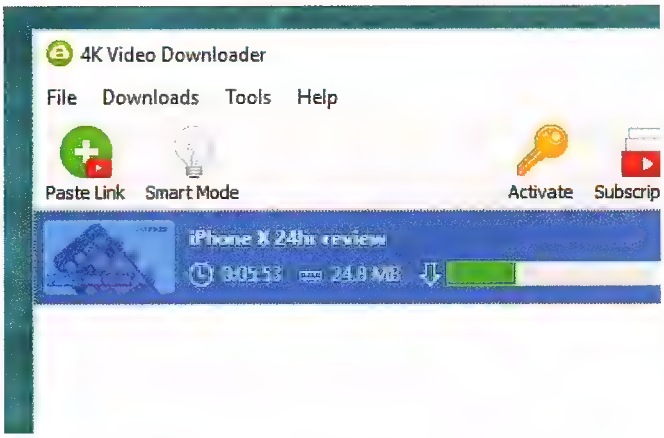
Convert a video to GIF format



Copy any YouTube video, playlist or channel link and click Paste Link
Grab videos with subtitles and annotations

1 FIND A VIDEO ONLINE

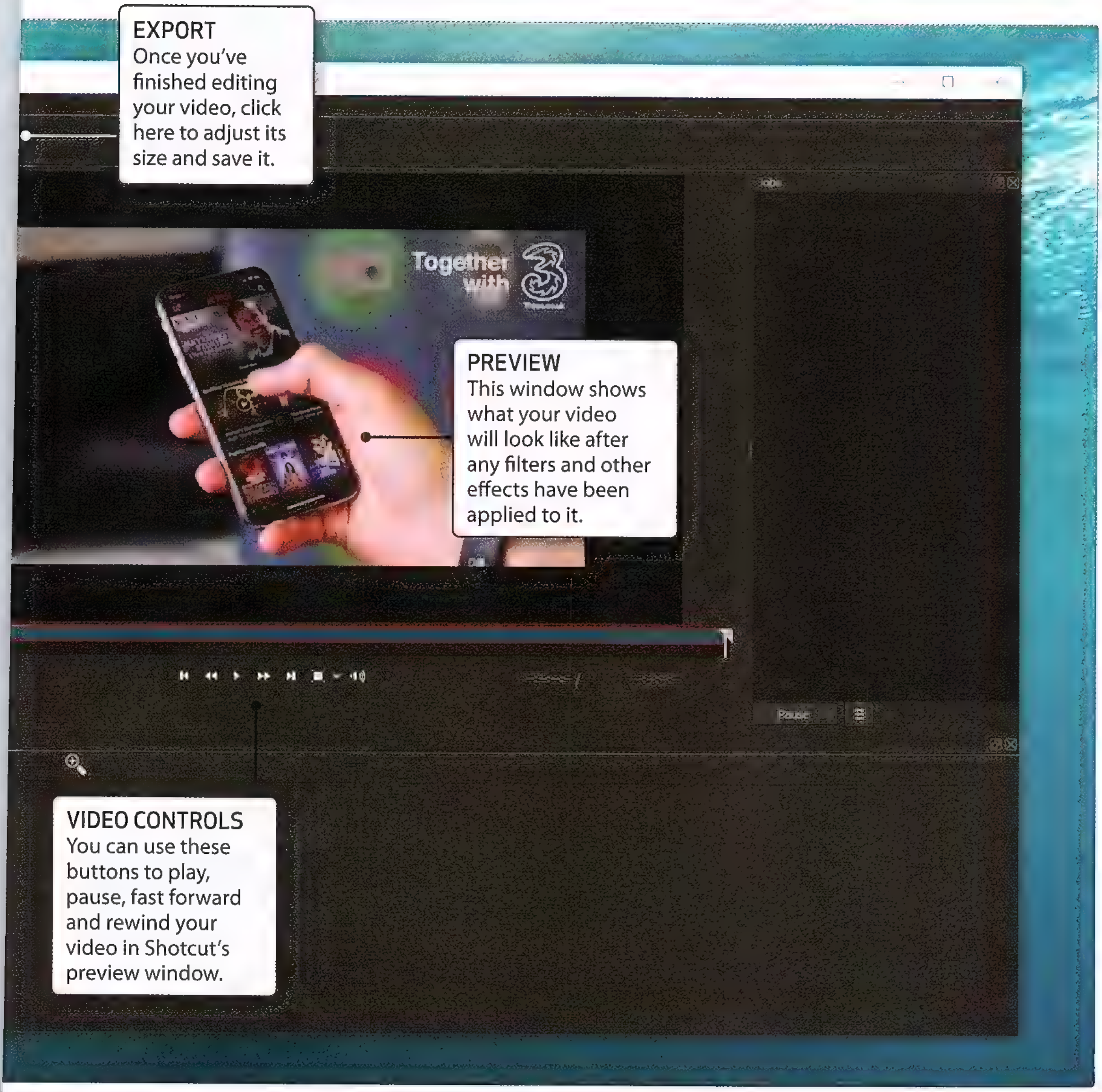
If you have the copyright holder's permission, or you uploaded it yourself, you can download a video from the web to turn into a GIF. Download and install 4K Video Downloader (**www.4kdownload.com**), then find the video you want online and copy its address from your web browser. Open 4K Video Downloader and click the green 'Paste link' button.



iPhone X 24hr review
0:05:53 24.8 MB

2 SAVE IT TO YOUR PC

You'll now be prompted to choose a quality option. Part of the appeal of animated GIFs is their small size, so the 'High quality 480p' option is fine. Leave the format as MP4, choose a location for the saved file – we recommend either your desktop or your Videos directory – and click Download. You'll see a green progress bar; once this is full, your video is ready.



EXPORT
Once you've finished editing your video, click here to adjust its size and save it.

PREVIEW
This window shows what your video will look like after any filters and other effects have been applied to it.

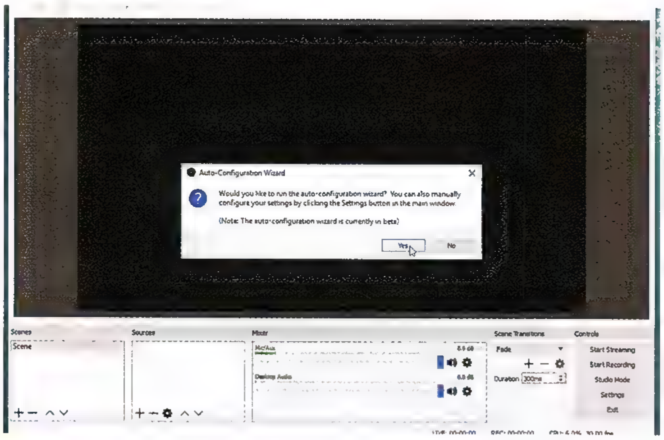
VIDEO CONTROLS
You can use these buttons to play, pause, fast forward and rewind your video in Shotcut's preview window.

Jargon buster!

GIF
Graphics Interchange Format – an image file type that supports animation and transparency.

HTML5
A programming language used for structuring online content, including video. It's supported by every modern web browser.

CODEC
A small program for encoding data, including videos.



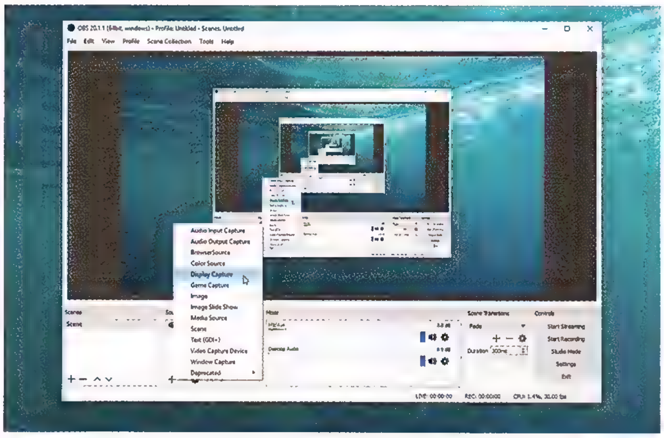
Auto-Configuration Wizard

Would you like to run the auto-configuration wizard? You can also manually configure your settings by clicking the Settings button in the main window.

(Note: The auto-configuration wizard is currently in beta)

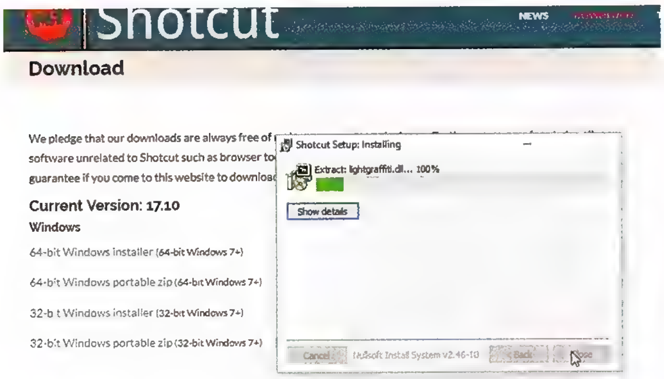
3 CAPTURE A VIDEO FROM YOUR SCREEN

If you want to make a GIF from a game or other software, you need free screen recorder OBS Studio. It might look intimidating at first, but it's remarkably easy to use. Download it from **https://obsproject.com/download** and run the installer. You don't need the plug-ins, so feel free to uncheck them. When it's done, launch the software and skip the optimisation wizard.



4 START AND STOP RECORDING

Click the '+' icon under Sources and select 'Display capture' from the drop-down menu. Click the 'Start recording' button on the right, then minimise OBS Studio and do whatever you want to record. When you've finished, maximise the recorder and click 'Stop recording'. The captured footage will be saved automatically in FLV format, and stored in your Videos directory.



Shotcut

Download

We pledge that our downloads are always free of
software unrelated to Shotcut such as browser to
guarantee if you come to this website to downloa

Current Version: 17.10

Windows

64-bit Windows installer (64-bit Windows 7+)

64-bit Windows portable zip (64-bit Windows 7+)

32-bit Windows installer (32-bit Windows 7+)

32-bit Windows portable zip (32-bit Windows 7+)

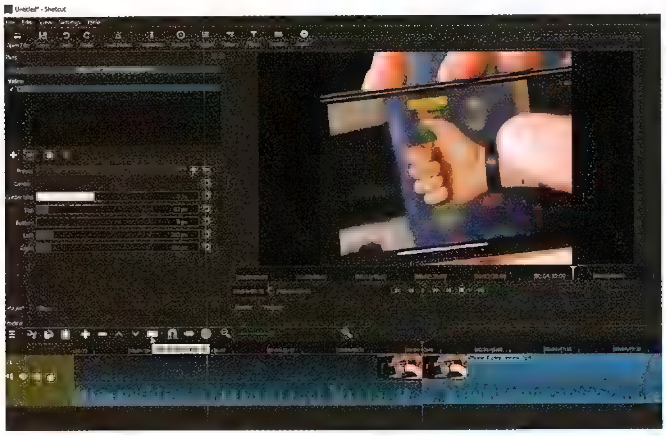
Shotcut Setup: Installing

Extract: lightgraffiti.dll... 100%

Nullsoft Install System v2.46-10

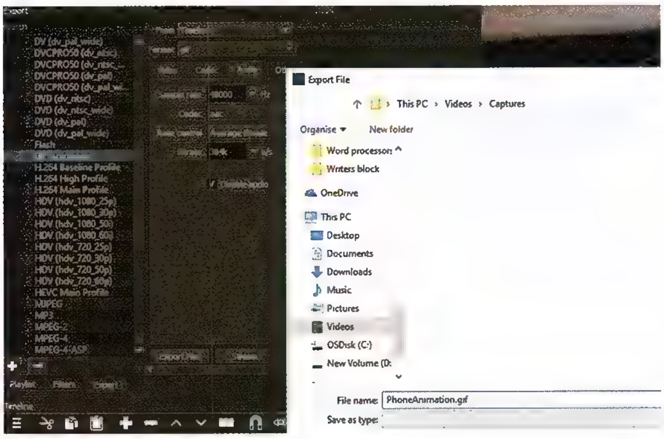
5 DOWNLOAD SHOTCUT

Whether you've downloaded a video, recorded your own, or found one somewhere else, Shotcut is the best tool for converting it to GIF format. It's totally free, doesn't add watermarks to your videos, and is packed with lots of handy tools and filters to make your GIFs look great. Download it from **www.shotcut.org** and run the installer. When it's done, click Close and launch the program.



7 KEEP IT BRIEF

Drag the video preview into the timeline at the bottom of the screen. Try to make your GIF ten seconds long or less. Drag the vertical white bar (the playhead) along the waveform until you find the point where you want your GIF to start and click 'Split at playhead'. Select the section of video you want to remove and tap [Delete]. Now do the same for the end of the video.



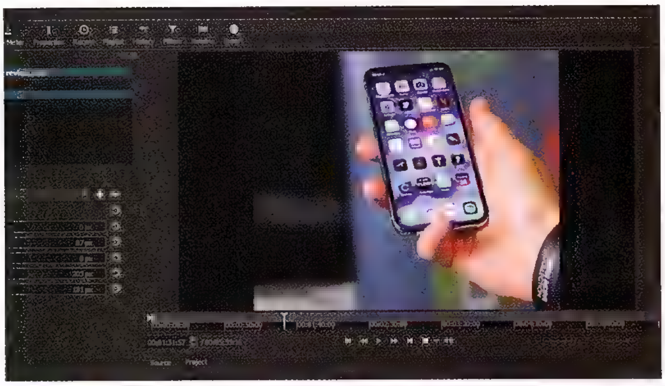
Export File

This PC › Videos › Captures

File name: PhoneAnimation.gif

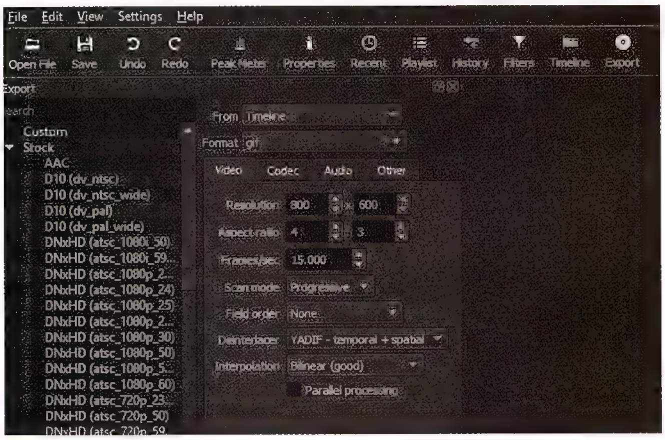
9 SAVE YOUR GIF

GIF format doesn't support sound, so click Audio and select 'Disable audio'. Reduce the frame rate to approximately 15fps, click 'Export file', give it a name ending in the extension .gif and click Save. A status bar on the right will show you when it's finished processing. Congratulations, you've turned a video into an animated GIF, ready to share wherever you like.



6 CROP YOUR VIDEO

Click 'Open file' and load your chosen video. GIFs work best if they're tightly cropped to focus on the most important part of the action. If your video needs cropping, click Filters, then click the '+' icon to add a new filter. Click the small monitor icon to see video filters, then click Crop. Now use the sliders to adjust how much is cut off the top, bottom and sides of the video.



From: Timeline

Format: gif

Resolution: 800 x 600

Aspect ratio: 4 : 3

Frames/sec: 15.000

Scan mode: Progressive

Field order: None

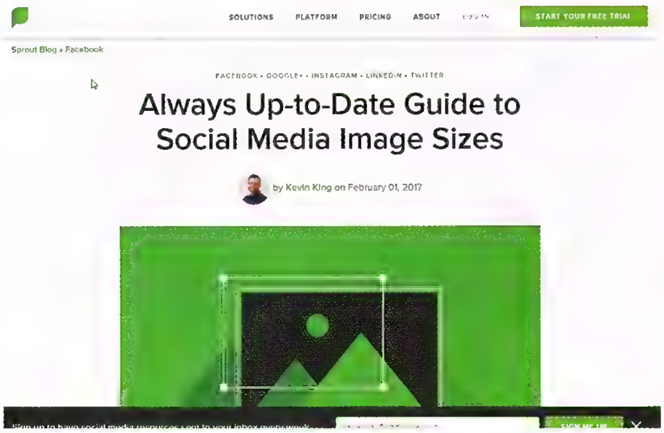
Deinterlacer: YADIF - temporal + spatial

Interpolation: Bilinear (good)

☐ Parallel processing

8 PREPARE TO EXPORT

When you've trimmed your video down to a few seconds, click Export and select GIF as the format. Now take a look at the resolution. The ideal size of the GIF will depend on where you're planning to use it, but a resolution of 800x600 should be fine for most purposes. Click the Codec tab and change the codec to GIF – you'll need to scroll down a little to find it.



Sprout Blog › Facebook

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Always Up-to-Date Guide to Social Media Image Sizes

by Kevin King on February 01, 2017

10 GET THE SIZE RIGHT

Want to share your GIF on a certain site, but not sure about the best size? Sprout Social has a handy guide at **http://bit.ly/2AtqVL4/** that shows you the optimum image dimensions for all the most popular social networks, including Twitter, Facebook and Pinterest. It's a very useful reference that will help ensure your GIFs look as good as possible when you publish them. ■

LATEST LAPTOPS REVIEWED HP SPECTRE PORTFOLIO & HUAWEI MATEBOOK X PRO

TECH AUSTRALIA life

WINDOWS, MAC, ANDROID & iPHONE HACKS

ISSUE 86 FEBRUARY 2019 TECHLIFER TECHLIFER APPLE NEWSSTAND & GOOGLE PLAY

10 SECRETS OF GREAT SUMMER PHOTOGRAPHY

HOW TO TAKE GREAT PHOTOS ANYWHERE, AND OF ANYONE

STUDENT LAPTOP BUYERS' GUIDE

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WE HELP YOU CHOOSE THE RIGHT TELEVISION, PLACE YOUR SPEAKERS, AND PICK OUT THE BEST SOUNDBARS FOR ANY BUDGET

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FUTURE

BEST FREE BACKUP SOLUTIONS

BACKUP YOUR PC AND PROTECT YOUR DATA!

PAGE 54

ON YER BIKE!

WHAT'S THE BEST ELECTRIC BIKE FOR YOU?

ESSENTIAL TECH NEWS, REVIEWS & KNOW-HOW:

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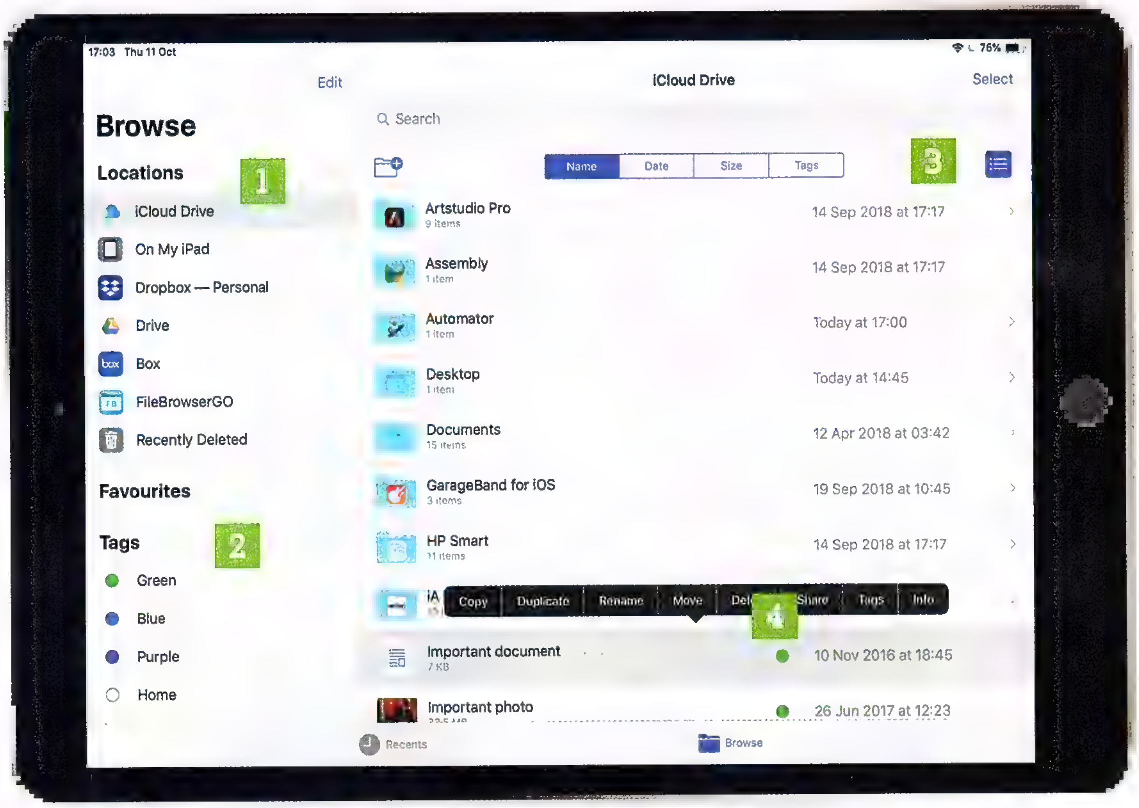
ON SALE NOW



1 LOCATIONS As well as your iCloud Drive and your device's own storage, you can add other cloud services here.

2 TAGS Applying tags helps you gather related files, even if those files come from different apps and/or locations.

3 OPTIONS You can sort the list of files by different criteria, and also switch between list and icon views.

4 CONTEXTUAL MENU Hold a finger on a file or folder for a moment to see actions you can take on it.

Get more from the Files app

Find the iOS file manager's hidden features and extend its powers. Adam Banks takes us on a deep dive.

Files is iOS's equivalent of Finder in macOS and enables you to browse files stored on your device's built-in storage or in iCloud Drive. You can also add other cloud services to browse them in the same interface and, with the help of a third-party app, access files on Macs, PCs and network-attached storage (NAS) drives.

By default, the only locations in Files' sidebar are iCloud Drive (assuming you have signed in to iCloud in Settings) and On My iPhone/iPad. These two locations work a little differently from one another, because folders on your device's storage are created and controlled by apps; you can't move or delete them yourself, or add new ones. However, you can create folders as you wish in iCloud Drive.

The large pane on the right is where you browse within storage locations. Simply tap to open a folder or file. By default, this pane isn't scrolled all the way to the top. Swipe down on it to reveal some extra options hiding above. Tap one of the attributes listed there – name, date, size or tags – to sort the pane's contents by it. Tap the list icon to the right to switch between icon and list views, and the folder icon to the left to create a new folder (on iCloud Drive). Tap a folder to look inside it. The previous folder's name appears at the top left, where you can tap it to go back.

You can add third-party cloud services, such as Google Drive, Box and Dropbox, under Locations in the sidebar. That enables you to manage them all in one place and copy files between them. By default, you can't add non-cloud storage, such as shared folders on your Mac or network-attached storage, but we'll show you a way around that.

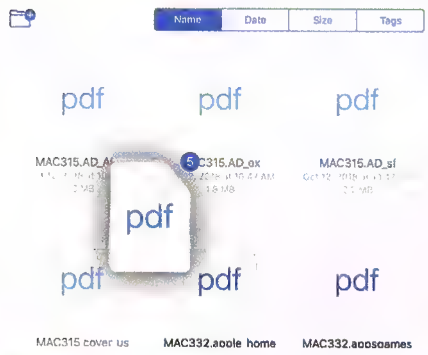
HOLD FOR THE OPERATORS

To reveal options for a file, long-press it: that is, hold a finger on a file for a moment, until it visibly lifts up, then let go. When you do this, a contextual menu of commands will appear. That works for one file at a time; for multiple files, tap Select, then tap the files you want to do something with and similar options will appear at the bottom of the screen.

When browsing your iCloud Drive, you can delete folders created by apps – typically emblazoned with the respective app's icon – if you want, but you can't move them. All the other options are similar.

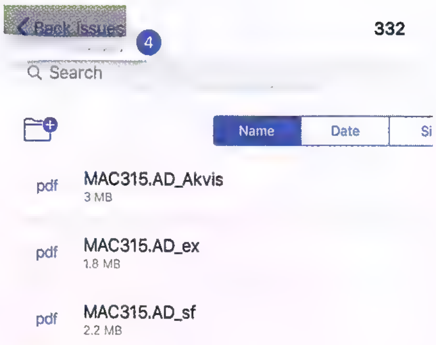
How to

Make the most of the Files app.



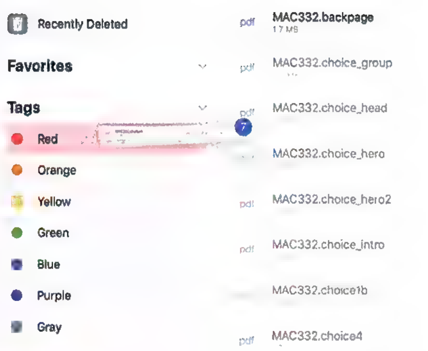
1 MOVE INTO/OUT OF A FOLDER

To move a file into a folder, drag it onto the folder's icon. To drag multiple files, hold a finger on one, start dragging, then tap others. To move a file out of a folder, drag it onto its parent folder's name (top left) and wait for that to open.



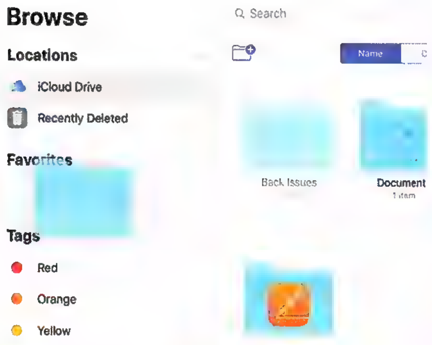
2 MOVE OUT OF A FOLDER

You can't drag between locations in Files' sidebar, but moving a file between them is possible: long press it, then tap Move and pick a location. To move, copy, delete or share several files, tap Select, tap the files, then a command.



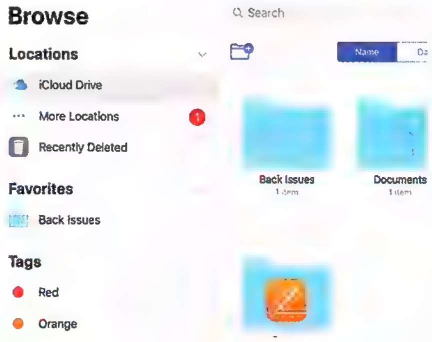
3 ASSIGN A TAG

To move or share files from several locations, use tags. Drag files and folders onto a tag in the sidebar; they are then marked with a dot of the tag's colour. Or, long press on one and tap Tag; this method also lets you create new tags.



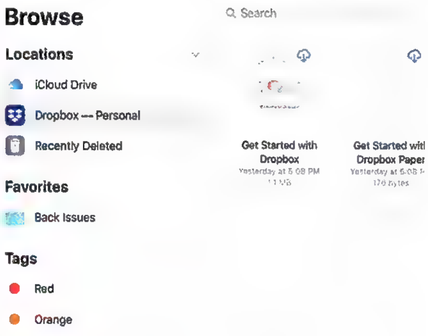
4 BROWSE TAGS/FAVOURITES

Tap a tag in the sidebar to see all items to which it's applied. Favourites in the sidebar are folders you'll want to revisit. You can add an item to that group by choosing Favourite in the options bar, or by dragging it there.



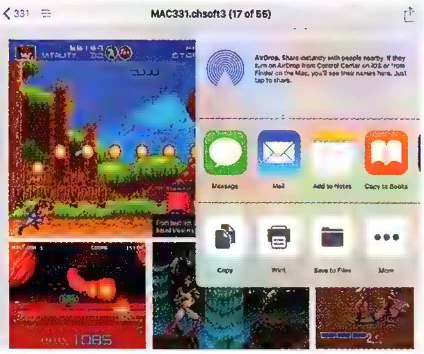
5 ADD OTHER SERVICES

To add a cloud service such as Box, Dropbox or Google Drive to Files, install its app on your device. The next time you open Files, tap More Locations in the sidebar and turn on the service's switch to pin it under the Locations heading.



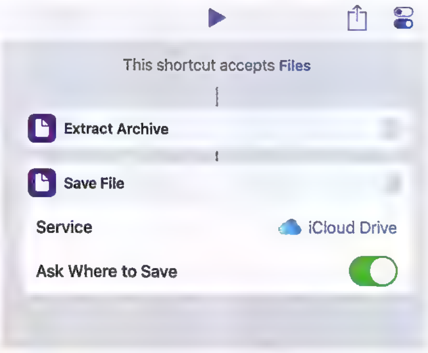
6 BROWSE OTHER SERVICES

From now on, just tap the service name to browse that storage. If you haven't recently logged in to the service in its app, the Files app will either show a pop-up or switch you to the app for you to log in before it can show your files.



7 EXTRACT FROM ARCHIVES

When you tap a Zip archive, you can then tap Preview Content to see what's inside, and preview files if iOS can handle their formats. While previewing a file, tap Share and choose Save to Files to unzip that file to a location of your choice.


This shortcut accepts Files

Extract Archive

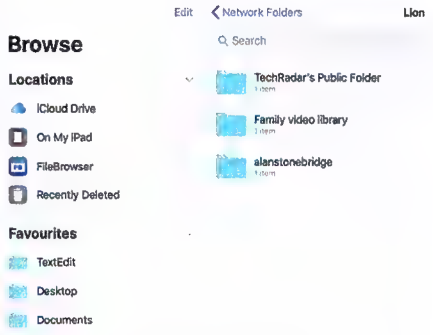
Save File

Service: iCloud Drive

Ask Where to Save ●

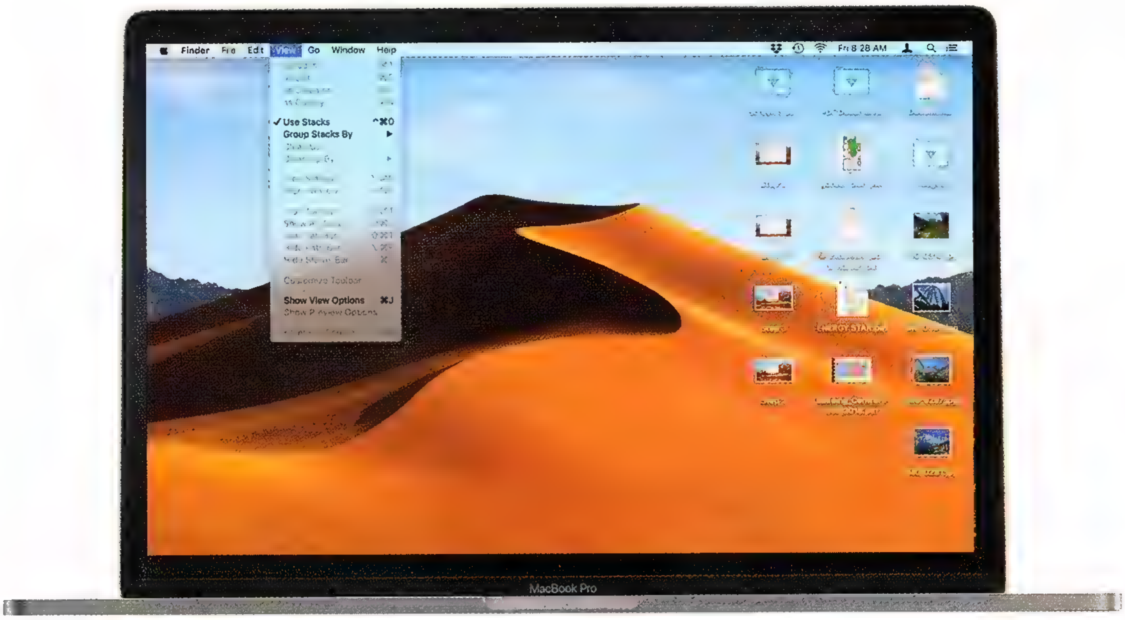
8 IMPROVE ARCHIVING

There's no built-in way to unzip a whole archive, but you can build one in Shortcuts. Add the Extract Archive and Save File commands. In the shortcut's settings, turn on 'Show in Share Sheet' and set it to accept files.



9 ADD NETWORK SHARES

FileBrowser ($9.99) enables you to browse folders shared on your network from within Files. In it, tap + and connect to a folder. In Files, tap More Locations, turn on FileBrowser, tap Done, then tap FileBrowser. Follow the on-screen steps.



Work smarter with files

Find things more easily with Mojave's desktop-organising enhancement. Kenny Hemphill helps you get organised.

One of macOS Mojave's headline features is Stacks, a way of organising files automatically on the desktop. The idea is to reduce clutter on the desktop by stacking similar files on top of each other. It's different to the stacks you can add to the Dock, by dragging a folder to the right end. When turned on, if you save or move a file to the desktop, it's added to the relevant stack.

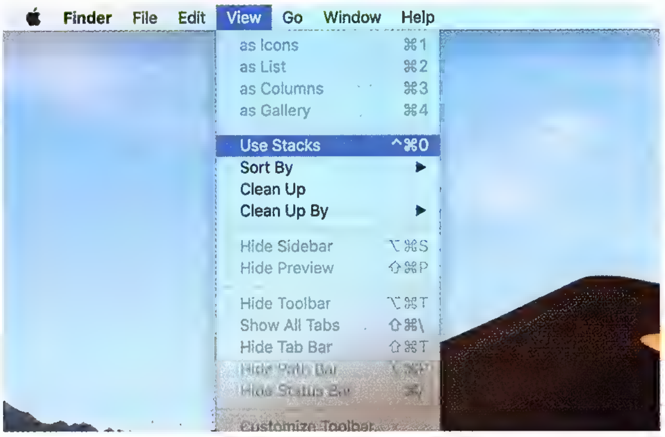
By default, stacks are organised by file type. So, for example, image files are stacked together, as are videos, and text documents. However, you can choose different criteria, such as the date files were last opened.

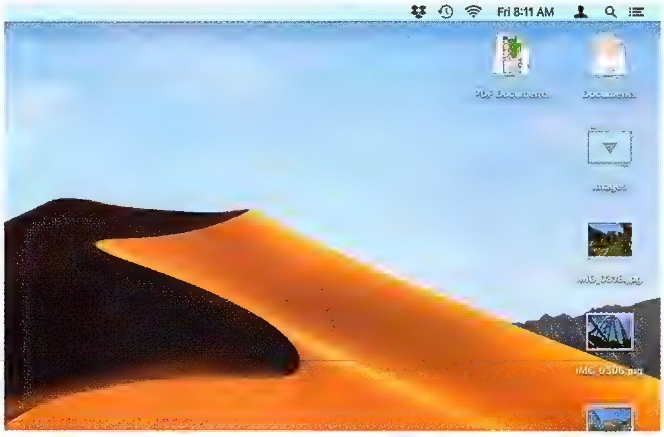
Files in a stack can be viewed together using Quick Look, or worked on using Quick Actions at the bottom of Finder's Preview pane (View › Show Preview). And if you'd rather move the files in a stack to a folder, you can do that quickly too.

When you turn off the feature, stacked files return to their original positions on the desktop.

how to

Work with Stacks.



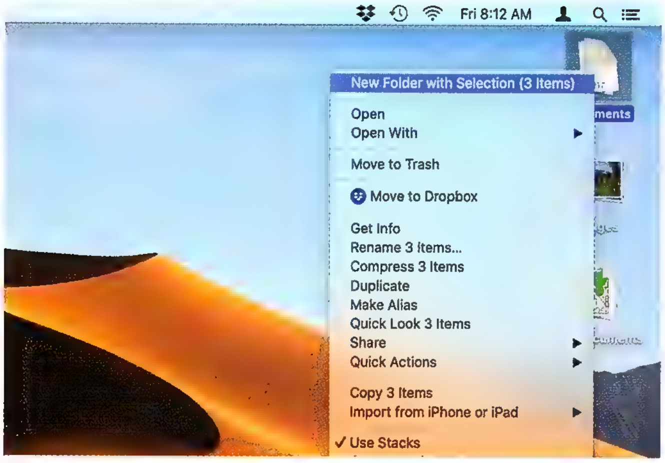


1 ORGANISE YOUR FILES

Click on an empty area of the desktop, then choose View > Use Stacks. Alternatively, Control-click anywhere on the desktop and choose Use Stacks, or click the desktop and press Control-Command-0 to toggle the feature on or off.

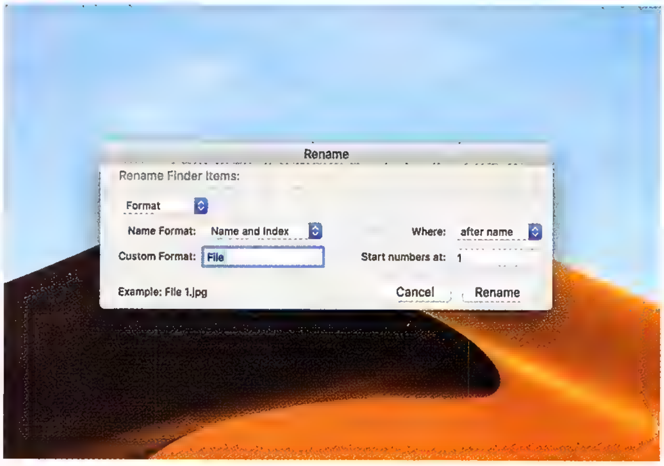
2 VIEW A STACK'S CONTENTS

A stack looks like a bundle of files, with only one file's thumbnail preview visible. Click on the stack to expand it and see the icons/previews of files within it. Click the arrow icon at the top of those files to close the stack.



3 CONVERT TO A FOLDER

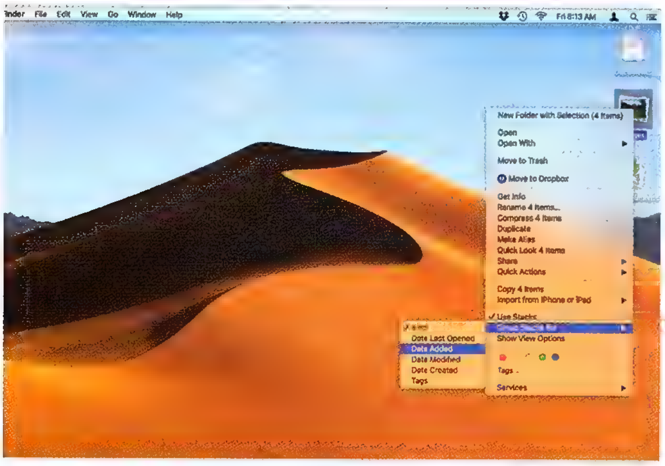
You can quickly turn any stack into a folder. Control-click on the stack and choose 'New Folder with Selection'. The stack will then be turned into a regular folder containing all the files that were in it.



Rename Finder Items:
Format
Name Format: Name and Index
Where: after name
Custom Format: File
Start numbers at: 1
Example: File 1.jpg

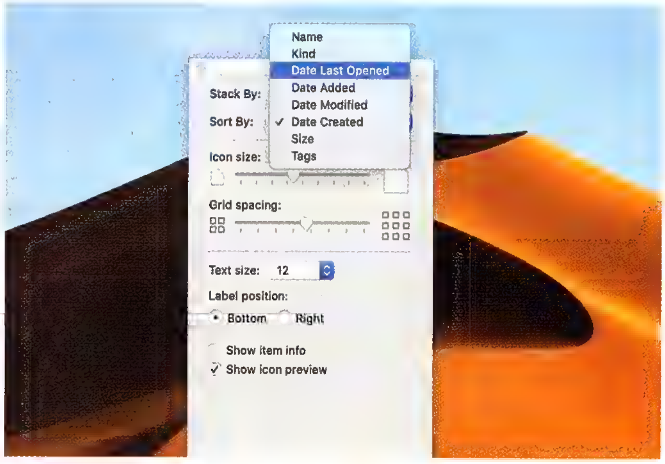
4 RENAME A STACK'S ITEMS

You can easily rename items within a stack. Simply Control-click on a stack and choose 'Rename <number> items'. Choose from the options in the window that opens to rename all the files according to the criteria you specify.



5 REORGANISE YOUR STACKS

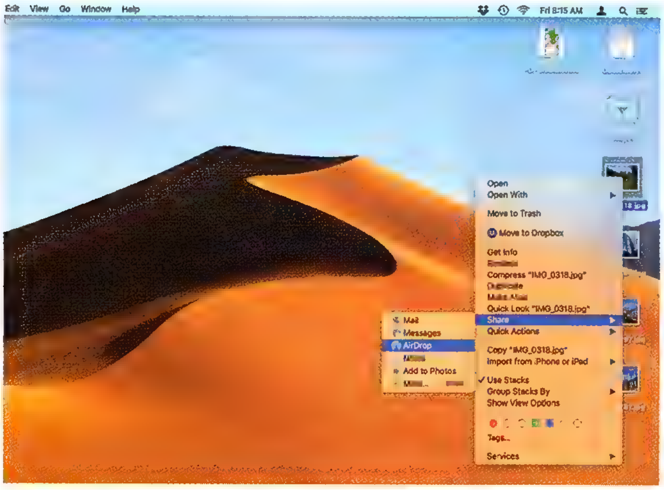
Open Finder's View menu or Control-click on the desktop to show its contextual menu, open the 'Group Stacks by' submenu and choose an attribute. If you pick None, files are unstacked and return to their original positions.



Stack By:
Sort By: ✓ Date Created
Icon size:
Grid spacing:
Text size: 12
Label position: ● Bottom ○ Right
☐ Show item info
☑ Show icon preview

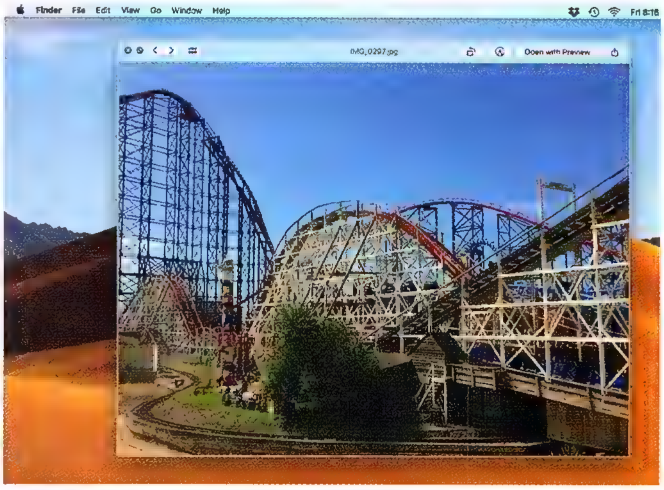
6 SORT ITEMS IN A STACK

With the desktop grouped in stacks, you can sort the items within the stacks. Control-click on the desktop, hold Option, then choose an attribute, such as 'Date last opened' from the Sort Stacks By option.



7 SHARE FILES IN A STACK

You can open a stack and drag a file to another folder or drive, or Control-click on it and choose Share to send it to an app, service or person. To share all files in a stack, Control-click on the closed stack, choose Share, then a method.



8 PREVIEW WITH QUICK LOOK

To browse a stack's contents, Control-click on it and choose 'Quick Look <number> Items'. Use the arrows (top of the Quick Look window) to navigate the file previews, view them in a grid, or use Finder's new Quick Actions on them. 🟩

Design a professional-looking magazine

John Knight attempts to make sense of the scary magazine editor Scribus and finds that the fuss was much ado about nothing.

We had a certain trepidation taking on Scribus. Although it's much more powerful than something like Microsoft Publisher, the interface is completely different to what most people are used to, which gives it an intimidating reputation. But this reputation is undeserved, and it can be an excellent way to get into do it yourself publishing.

Covering all of Scribus could fill an entire magazine, so instead we'll take you through the primary elements of the interface, giving you enough to get started. We'll be focusing on making a magazine, but the same principles can be applied to anything like a community newsletter or a school newspaper.

The easiest way to get into Scribus is to work from a template, and for many projects it may be sufficient to simply find a template you like and just replace the text and images. So we'll begin with a template, and then start from scratch to explore the rest of the GUI.

NO NEW IDEAS

When you start Scribus, the New Document window will open automatically with the New Document tab, ready to start from scratch. We're not quite ready for that yet, so if you look to the right, the next tab is called New from Template. Here you'll find a reasonably large selection of templates with a description on the right.

To keep things simple we decided on 'Newsletter 1'. It's quite straightforward in its layout, its images are all free, and its author has designed it so you can simply replace any text or images with your own.

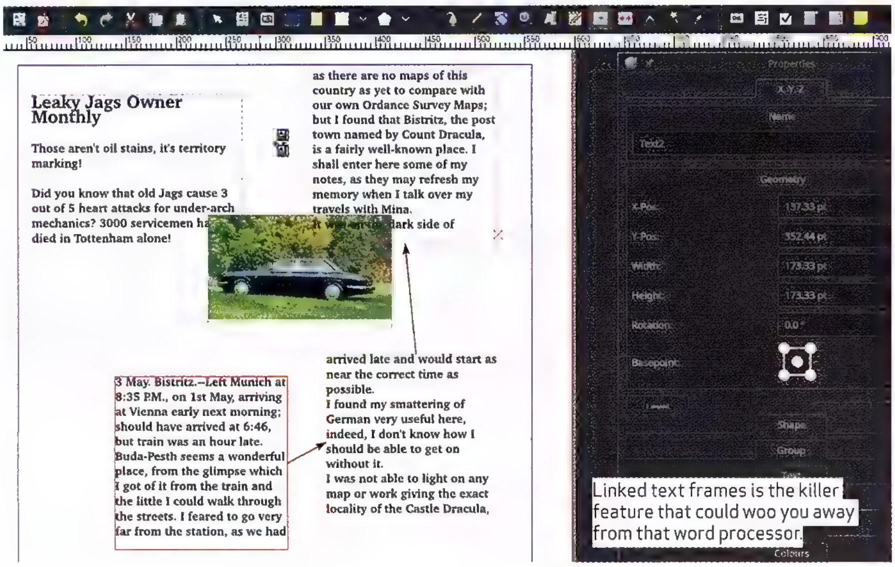
Although the controls in Scribus can get quite technical, at its heart it's quite simple and revolves around two concepts: everything sits in frames and it's all stacked in layers.

Scribus is designed primarily around Text Frames and Image Frames. Whether you're working on text or images, either kind of frame can be resized or reshaped to taste, and you can generally replace any existing content with whatever you like. Let's start with text.

ADDING TEXT

Pick any text frame you like and right-click. A menu will appear with quite a number of options, but for now we'll be looking at two: Get Text and Edit Text. Get Text will take the content from an external file and put it straight into the frame. Very cool, but you're more likely to just copy and paste into Edit Text.

Edit Text opens the Story Editor window, which resembles a basic word processor. Most of the controls you should be able to guess, though there are a few oddities. When you're done editing you can just click the big green tick button. However, there's no preview function in the Story Editor, so you'll need to keep clicking Edit Text every time you want to make a change.



Leaky Jags Owner Monthly

Those aren't oil stains, it's territory marking!

Did you know that old Jags cause 3 out of 5 heart attacks for under-arch mechanics? 3000 servicemen ha[illegible] died in Tottenham alone!

as there are no maps of this country as yet to compare with our own Ordance Survey Maps; but I found that Bistritz, the post town named by Count Dracula, is a fairly well-known place. I shall enter here some of my notes, as they may refresh my memory when I talk over my travels with Mina.
It [illegible] dark side of

3 May. Bistritz.--Left Munich at 8:35 P.M., on 1st May, arriving at Vienna early next morning; should have arrived at 6:46, but train was an hour late. Buda-Pesth seems a wonderful place, from the glimpse which I got of it from the train and the little I could walk through the streets. I feared to go very far from the station, as we had

arrived late and would start as near the correct time as possible.
I found my smattering of German very useful here, indeed, I don't know how I should be able to get on without it.
I was not able to light on any map or work giving the exact locality of the Castle Dracula,

Name: Text2
X-Pos: 137.33 pt
Y-Pos: 352.44 pt
Width: 173.33 pt
Height: 173.33 pt
Rotation: 0.0 °
Basepoint:

Linked text frames is the killer feature that could woo you away from that word processor.

It's better to move the Story Editor to the side so you can see the original text frame you want to edit. Then when you've made some changes, click Update Text Frame from the Story Editor's main toolbar and you'll see your original text frame change in the main window.

IMAGE CONTROL

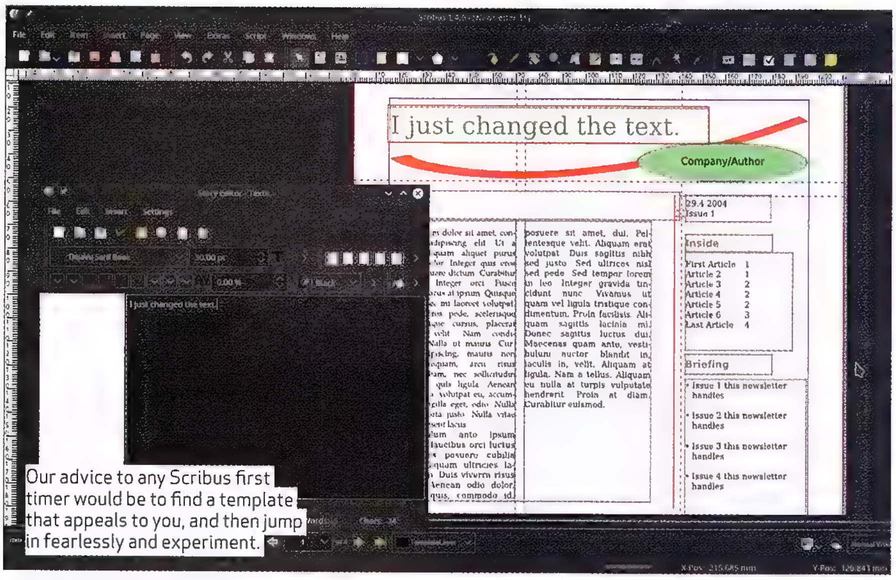
To replace an image, right-click in the frame and choose Get Image. This will open a file browser. Click OK when you've chosen your image. The picture frame will now have your image but unless the aspect ratio was the same the dimensions will probably be wonky, with some white space left in the frame, or only part of the image.

To alter an image's dimensions right-click the image and choose Properties. In the Properties window, click the Image tab. The options Scale To Frame Size and Proportional might be enabled. If so, then one possible fix for a badly filled frame is to uncheck the Proportional box, which will then stretch the image to fit the frame.

However, this may look horrid, so you can fine-tune the image by clicking the Free Scaling option, where you can move and stretch the image to your heart's content. Or you can resize the picture frame to fit.

In the Newsletter 1 template the image and text frames are locked in place, meaning that you can't resize them. To unlock the frames, right-click any image or text frame and uncheck the option 'Is Locked', and you can now resize the frame as much as you want.

With any luck, working from a template will have been sufficient to create the document you wanted. If so, save your work and export it. The native Scribus format is .sla, but if you're sending your work to anyone other than a fellow Scribus user, you need to use something more universal like PDF. That's easily done, by clicking File›Export›Save as PDF.



I just changed the text.

Our advice to any Scribus first timer would be to find a template that appeals to you, and then jump in fearlessly and experiment.

Note that in both exporting files and in Print Preview you'll likely encounter warning messages. That's quite normal – Scribus is pretty pedantic! Ignore them, you'll probably be fine.

FROM SCRATCH

If you have something more specific in mind a template probably won't cut it, meaning you'll need to build up your own document from scratch. But don't worry, we're here to take you through the basics.

For a starting point, if you have something like a magazine whose style you want to imitate it's worth getting out a ruler and measuring the dimensions of every box, row, image, and column. The Scribus layout can be set to operate within physical dimensions, meaning you should be able to replicate the formatting elements of your favourite magazine.

Muggins here and his brother have been trying to replicate the style and feel of Commodore Format from the early '90s, so we can work on our own book and provide a cool template for other retro gaming authors. Aside from copying the physical dimensions and styling language, those magazines usually had a three column layout, so that's a good place to begin. Bring some formatting ideas of your own and we'll get started.

Click File>New to start afresh and the New Document window will appear, where you define your layout. To keep things simple we'll stick with a Single Page layout. Otherwise everything's fairly conventional except the choice of Default Unit, which is "Points (pt)". Goodness knows what that means, so switch it to something useful like millimetres!

Now you can easily define the page margins on the left, and if you check the "Automatic Text Frames" box, you can set the number of columns and the gap between them. If you just want a normal full page of text leave Columns as 1, but most magazines use two or three columns, and newspapers usually use four.

TEXT FRAMES

When you click OK you'll have a blank page with three columns, if that was your choice. The column markers will act as visual guides, and if you check your work in Print Preview you'll see these ugly things are thankfully not included! The obvious place to start would be with some text, so let's create our first Text Frame.

In the middle of the main toolbar is the Insert Text Frame button. On your blank page click and place your first frame wherever you like. You can even overlap the column guides and page borders if you want – this can be changed though, see the box on guides for more information. Note that Scribus will switch back to Select Item mode after you've inserted a frame, so you'll need to click the button each time you want to generate a new text frame.

To add text use the same method as before, right-clicking and choosing Edit Text. If you happen to run out of space in your first frame, don't worry. Create a few more blank frames and we can explore one of the coolest features in Scribus: linked text frames, where text flows seamlessly from one frame to the next.

Start by selecting the frame from which all other frames will be linked. If you click Link Text Frames from the main toolbar, your mouse pointer will change to an image of two text frames with a linking arrow. When you click the next frame they will be linked.

Now you never need worry about having too much text for one box. Just write away to your heart's content and whatever doesn't fit in the first frame will simply run into the next. You can do this multiple times to create elaborate designs. You can link frames up or down, in any direction. You can even skip over other frames, leaving space in the middle.

Whenever you link multiple frames Scribus will use arrows to show which frames are linked and in which direction. You'll know if a frame is linked if you click it and you're given the option to use the Unlink Text Frames button. If you do so, Scribus will actually point to the frame about to be Unlinked, just to be helpful.

IMAGE FRAMES

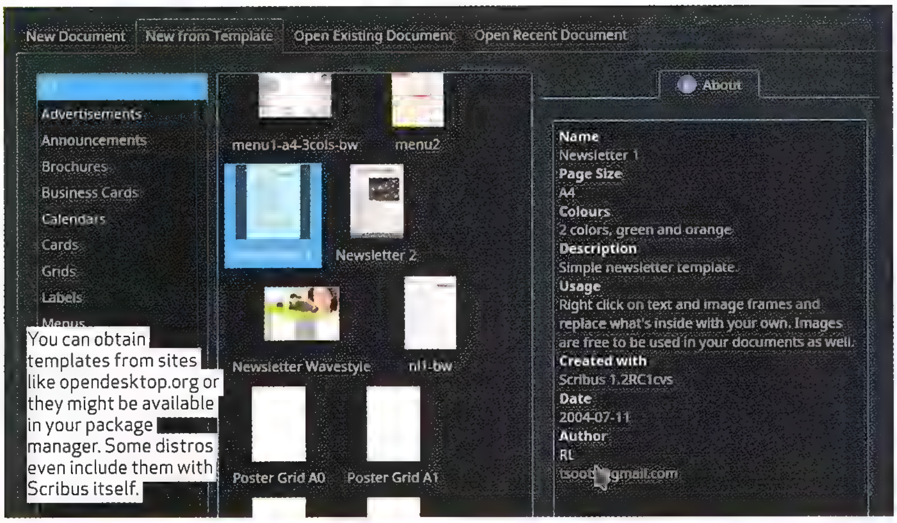
Inserting an image frame is the same process as a text frame. Click the Insert Image Frame button in the main toolbar, then click and drag the dimensions of the frame to suit. Right-click inside the frame and choose Get Image which opens the file browser. Like text frames you need to click the Insert Image Frame button each time you want to make a new one.

Using The Grid

If you click View>Show Grid, an overlay in the style of technical graph-paper will appear, with big cubes (the major grid) containing smaller cubes (the minor grid). You can either use this grid as a simple visual guide, enabling you to still draw freehand and place things where you like, or you can make objects rigidly "snap" to it. If you're making a garish magazine with free-flowing objects then leave it as it is. But if you're making something quite conservative with many pages to produce, you want the snap function.

By default the grid will simply act as a visual guide, but if you want to enable the snap function, from the main menu choose Page>Snap to Grid. However, the default grid sizes are a bit weird and the page margins don't fit within them properly.

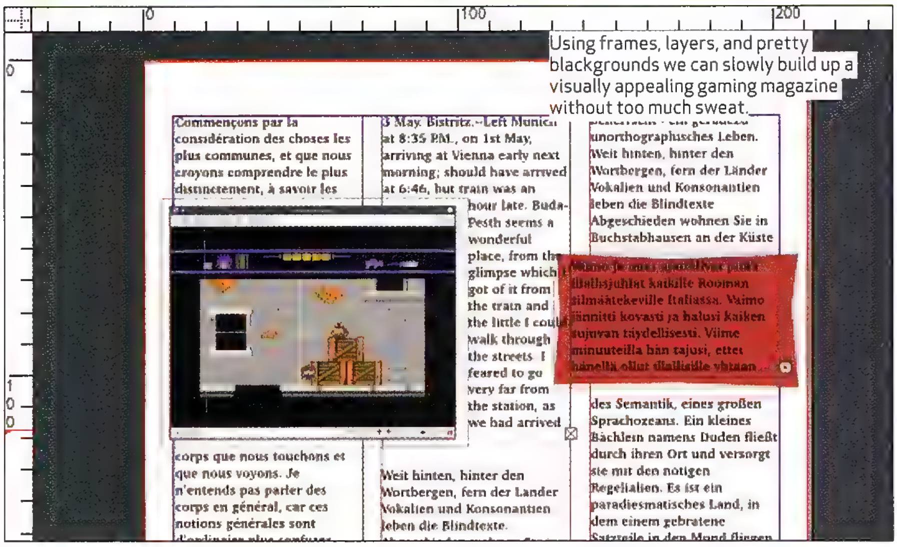
To make the grid more useful, change its settings by clicking File>Document Setup, and in the new window click Guides. If you enable the Show Page Grid option this will let you modify the grid settings. The default spacing is 35.278mm for the Major Grid and 7.056mm for the Minor Grid. If you change these to an even 35mm and 7mm, respectively, the page margins will now fit within the grid.



Name
Newsletter 1
Page Size
A4
Colours
2 colors, green and orange
Description
Simple newsletter template.
Usage
Right click on text and image frames and replace what's inside with your own. Images are free to be used in your documents as well.
Created with
Scribus 1.2RC1cvs
Date
2004-07-11
Author
RL
tsoots gmail.com

You can obtain templates from sites like opendesktop.org or they might be available in your package manager. Some distros even include them with Scribus itself.

> "Once you start getting into images used within layers, that's where Scribus really starts to get interesting."



Using frames, layers, and pretty blackgrounds we can slowly build up a visually appealing gaming magazine without too much sweat.

Commençons par la considération des choses les plus communes, et que nous croyons comprendre le plus distinctement, à savoir les

corps que nous touchons et que nous voyons. Je n'entends pas parler des corps en général, car ces notions générales sont

3 May. Bistritz.--Left Munich at 8:35 P.M., on 1st May, arriving at Vienna early next morning; should have arrived at 6:46, but train was an hour late. Buda-Pesth seems a wonderful place, from the glimpse which I got of it from the train and the little I could walk through the streets. I feared to go very far from the station, as we had arrived

Weit hinten, hinter den Wortbergen, fern der Lander Vokalien und Konsonantien leben die Blindtexte.

unorthographisches Leben. Weit hinten, hinter den Wortbergen, fern der Länder Vokalien und Konsonantien leben die Blindtexte Abgeschieden wohnen Sie in Buchstabhausen an der Küste

[illegible]
illallisjuhlat kaikille Rooman silmäätekeville Italiassa. Vaimo jännitti kovasti ja halusi kaiken sujuvan täydellisesti. Viime minuuteilla hän tajusi, ettei hänellä ollut [illegible]

des Semantik, eines großen Sprachozeans. Ein kleines Bächlein namens Duden fließt durch ihren Ort und versorgt sie mit den nötigen Regelialien. Es ist ein paradiesmatisches Land, in dem einem gebratene

As in the template section, your image will probably be the wrong size and resolution for the frame you've just made. To fix it, right-click the image and choose Properties. In Properties click the Image tab and choose Scale To Frame Size.

If Proportional is checked, the image will maintain its original aspect ratio. If so then there will likely be some leftover bits of frame, so you'll need to move back the borders to suit the image. If you leave Proportional unchecked the image will be stretched to fill the frame.

For elements such as clipart and small logos, you'll probably want to have transparent backgrounds. Transparent backgrounds enable you to have a background colour, and placing a new image over the top won't leave clashing borders or colours. It'll also help in the next two sections, with bold shapes you want to layer over something else, or when having text flow around a frame.

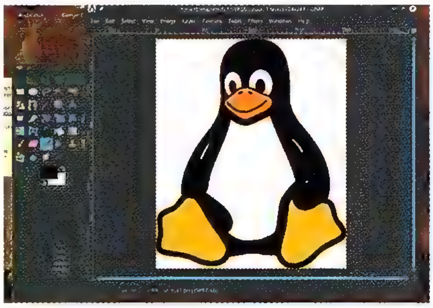
CONTROL LAYERS

Once you start getting into images used within layers, that's where Scribus really starts to get interesting. With layers you can create complex imagery and work on parts of a scene independently without upsetting anything else.

For instance, you can have a static background image and then place your own images on top – which by the way, is a primary technique in animation. In fact, if you think of an animator with pieces of celluloid, where they stack individual drawings over backgrounds, it's the same concept. Anything you do in one layer won't affect whatever is above or below it.

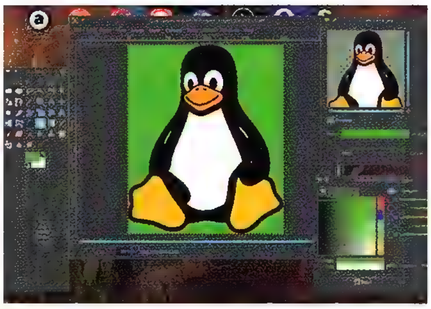
Indeed, if you try to approach Scribus from a reference point of something perhaps like Microsoft Word, everything will appear alien and nightmarishly complicated. But if you

Giving your pictures transparency with Gimp



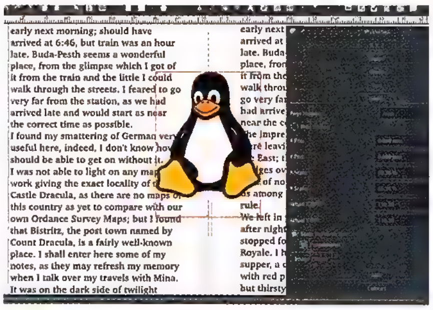
1 SOLID BACKGROUND

GIMP is the image editor used by Scribus. First, make sure your image has a solid background colour that can be easily differentiated by the computer from the rest of the image. White is good, or green for any users of green screen digital effects.



2 COLOUR TO ALPHA

With your image open, from the main menu click Colours>Colour to Alpha, and click OK. If all goes well it should detect everything automatically and separate the object from the background. If not, you may need to use the Color Picker tool.



early next morning; should have arrived at 6:46, but train was an hour late. Buda-Pesth seems a wonderful place, from the glimpse which I got of it from the train and the little I could walk through the streets. I feared to go very far from the station, as we had arrived late and would start as near the correct time as possible.
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I was not able to light on any map or work giving the exact locality of the Castle Dracula, as there are no maps of this country as yet to compare with our own Ordance Survey Maps; but I found that Bistritz, the post town named by Count Dracula, is a fairly well-known place. I shall enter here some of my notes, as they may refresh my memory when I talk over my travels with Mina.
It was on the dark side of twilight

3 EXPORTING YOUR IMAGE

If you don't have the option to choose Colour to Alpha, change the image to RGB mode by clicking Image>Mode> RGB. Note that you have to save your image as either a PNG or GIF, as JPEG files don't have background transparency.

think in terms of actual pieces of paper, celluloid, and scissors then it all becomes much easier to grasp.

For a good example of layering we thought we'd look to the vintage gaming magazines that we're imitating, where they take bright edgy shapes and use them for eye-catching boxouts. First we'll put a coloured polygon in an image frame, then put a text frame on top. Finally, we'll put a pretty background behind it all.

First we created the image frame to fit both an image and a separate text frame inside it, which meant deliberately spilling over the column borders (which was a very 90s thing to do!).

To achieve the right size we opened the frame's Properties, and opened the Image tab. From here we enabled Scale To Frame Size but didn't enable Proportional, which meant we could resize the shape and frame to perfectly fit a paragraph inside. Next, we drew a text frame on top of the shape and inserted some informative and entertaining text.

Now is a good point to explore Scribus's layer controls. For now the text is sitting above the image as it should be, but what if mis-clicking an option somehow got it the wrong way around – how would you correct that? So for now we're deliberately going to obscure the text layer behind the image layer, but then bring it back again.

Right-click the text frame and choose Level>Lower. The text should now be hidden while the image sits on top. To bring back the text, you'll need to lower the level of the image, so right-click and choose Level>Lower again. This will move the image back behind the text and restore the text layer to the top.

Now to give it all a background. We already prepared a simple background with a pretty colour-fade in using GIMP, though any portrait image should do. Then we simply drew an Image Frame across the entire page and inserted an image. Initially this just obscured everything, but by clicking Level>Lower to Bottom it put everything else back in the foreground while providing a nice background.

THE TEXT MUST FLOW

For the last piece of the puzzle, Scribus makes it possible to place graphics anywhere you like within text and force the surrounding text flow around it. If you create an image frame that overlaps text frames, you can try out the feature by right-clicking on the image, choosing Properties, and opening the Shape tab. In the field Text Flow Around Frame we want to focus on four options: Disabled, Use Frame Shape, Use Bounding Box, and Use Contour Line. Disabled turns off the feature entirely and text will just run over or under the image, ignoring its shape altogether. Use Frame Shape will make your text strictly adhere to whatever shape you have given the frame. Use Bounding Box will make sure that text will always conform to a perfectly rectangular field around the image. This can leave big empty gaps, but it may be just the look some people are going for.

For the advanced users out there, there's the Use Contour Line option. This is hard to explain without a live demonstration, but this adds a second shape for text to flow around, independent of however the image may look right now.

The contour will be based on whatever the image's original frame was, but by clicking Edit you can make the shape just about anything you like using some fairly intricate controls.

Using Guides

Guides are a tricky thing in Scribus. If you open the main menu and click View> Show Guides, it turns on the big ugly lines that show where everything goes. This may or may not be enabled by default according to the whims of the document. Turning them on or off will probably result in nothing with a brand new document, as they are generally things you need to define yourself.

For new documents, Page>Snap to Guides is less useful than Snap to Grid, because it will only snap to the page borders and not the columns – one would assume Snap to Guides would work with columns from the outset. Unfortunately, if you want to have your frames snap to columns, you will need to enter these manually in the Guide Manager (from the main menu click Page>Manage Guides). This is a right faff and we just don't have space to cover it this month.

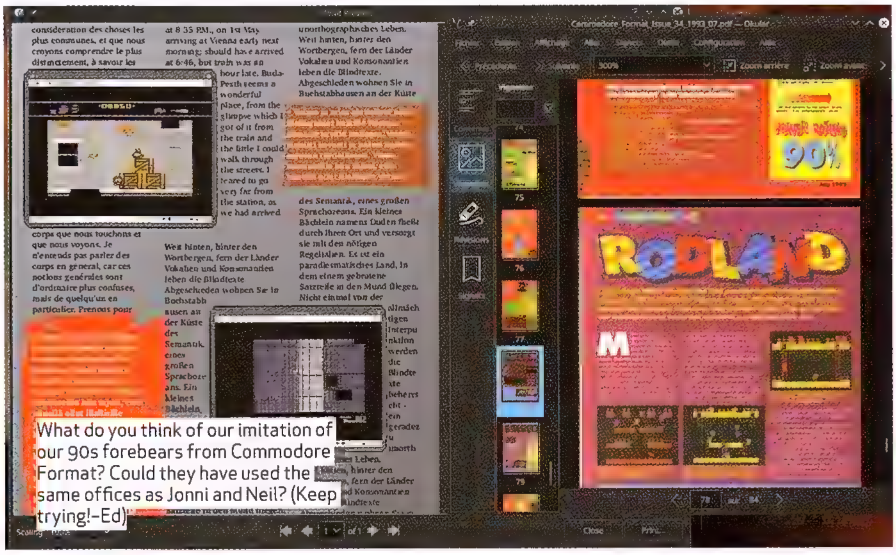
For most people, drawing boxes freehand with a visible guide will suffice, though if you're going to be working within the same layout day after day it's probably worth doing. But we'll let you work out for yourself where each row and column sits as it's beyond tedious to try and write about!

READY FOR MORE?

After you've finished your formatting and established a feel, you can create an entire magazine based upon your own style and tastes. You can also use this as a template, creating a distinct style your readers may enjoy.

This month we've only covered the basics of a magazine layout, taking a more text-based approach. Next month we'll focus more on graphics, such as covers, posters, and so on.

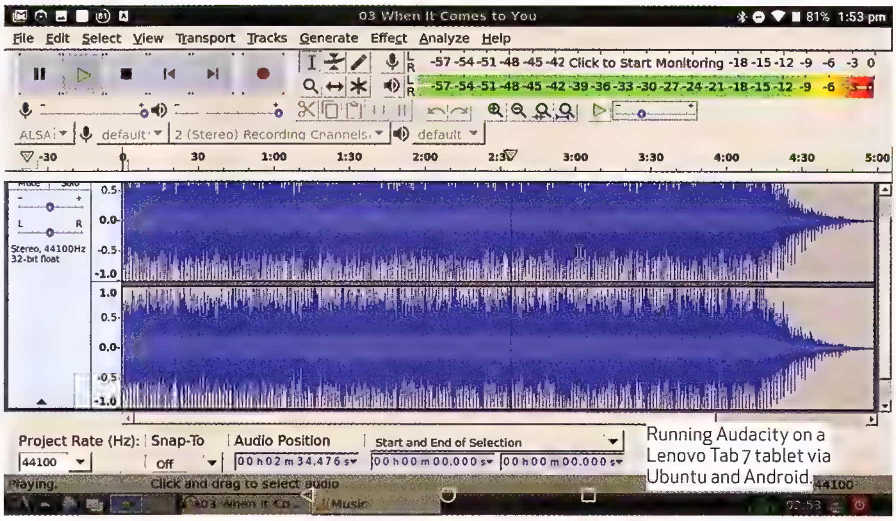
Obviously this isn't an environment to replace your word processor, but if this were something like Word or LibreOffice Writer, you would agonise endlessly trying to get a graphic to sit in the right place, constantly afraid you would upset the fragile formatting. In Scribus you just click this, drag that, and you're done. The interface isn't necessarily difficult, it's just different. Stick with it and you'll be rewarded. 🟩



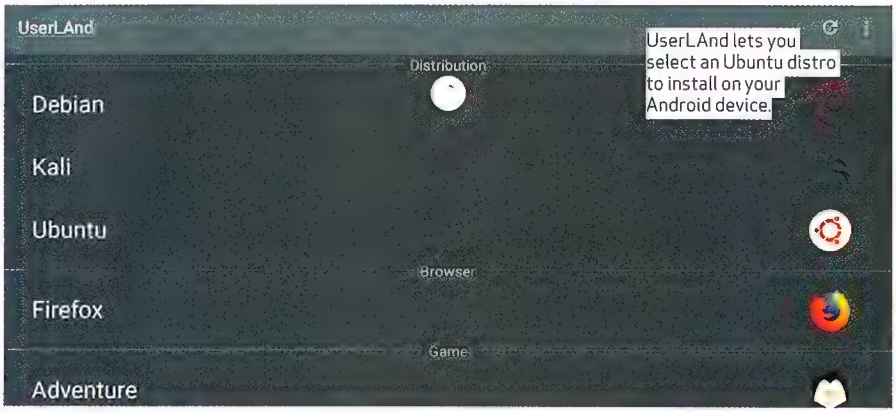
What do you think of our imitation of our 90s forebears from Commodore Format? Could they have used the same offices as Jonni and Neil? (Keep trying!–Ed)

Run Ubuntu Linux on Android – Version 2.0

Running a full Linux distro on your Android tablet isn't as dopey as it sounds – but the best technique for doing so has changed. **Darren Yates** explains what you do.


03 When It Comes to You
File Edit Select View Transport Tracks Generate Effect Analyze Help
Click to Start Monitoring
ALSA
default
2 (Stereo) Recording Channels
Stereo, 44100Hz
32-bit float
Project Rate (Hz):
44100
Snap-To
Off
Audio Position
00 h 02 m 34.476 s
Start and End of Selection
00 h 00 m 00.000 s
Playing.
Click and drag to select audio

Running Audacity on a Lenovo Tab 7 tablet via Ubuntu and Android.



UserLAnd lets you select an Ubuntu distro to install on your Android device.

Android tablets have fallen out of favour a bit these days, what with all the big screen phones hitting the market. Yet, they can still be incredibly powerful devices – even the occasional $99 budget 7-inch model. Last year, we showed you how to install and run a full Linux desktop distro as an app on Android. Since then, the GNURoot app that made it possible hasn't kept up with Android changes, but there's a more recent alternative we think is better. This month, we're showing you this new technique for running Ubuntu 18.04.1 LTS Linux on your Android device – and you don't need root access.

SURPRISINGLY USEABLE

Now I can hear you lot in the back seats calling out that Android-grade hardware is too slow to run Linux as a virtual machine on Android. And you're right. But we're not running it as a virtual machine – not in the 'VirtualBox' sense, anyway. Instead, we're using a lower-spec chroot environment (actually, a user-space version called 'proot'). That's why we can run an LXDE-based Ubuntu desktop on a $99 Lenovo Tab 7 Essentials tablet with Android 7.0, a budget quad-core Cortex A35 CPU and have it not be terrible. Sure, it's not PC-fast, but it's certainly useable.

WHAT YOU NEED

First up, you need an Android tablet (although a phone will work at a pinch), but it should have a quad-core CPU and must have Android 5.0/Lollipop or newer OS. Next, you need to install three apps from Google Play – all of them are free and none of them require root access.

Start with UserLAnd (**tinyurl.com/y8sq23tr**), followed by bVNC (**tinyurl.com/q5taybm**) and XServer XSDL (**tinyurl.com/mbyjjcx**). When you're ready, launch bVNC, don't make any changes (just let it setup), then launch UserLAnd. When UserLAnd fires up, look over the 'Distribution' List and select 'Ubuntu'. Approve access to your device storage. You'll also be asked to set a username and password and select a connection type between SSH and VNC. Select VNC, then press 'Continue'. This will now setup the root filesystem and install a core of Linux utilities. When it's complete, bVNC will launch automatically with a small but functional terminal.

INSTALLING A DESKTOP

Before you do anything else, you should ensure you have the up-to-date distro repository file listings. You do that by running the following in the bVNC terminal:

```
sudo apt-get update
```

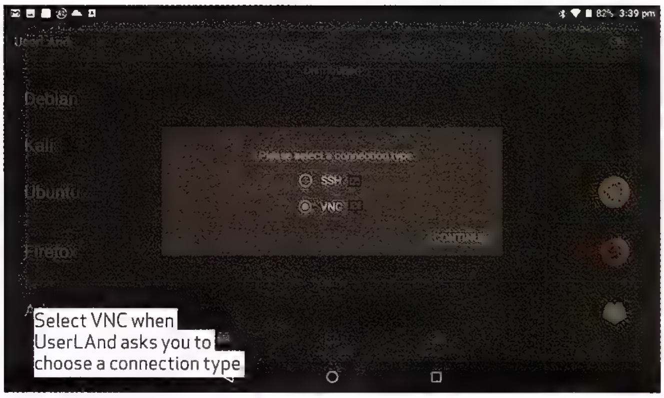
Now you're ready to install a desktop environment and the one we recommend is LXDE. It's a lean, lightweight environment that has a GTK+ look about it like Xfce and GNOME 2, but is ideal for Android tablets. Install the core components using the command:

```
sudo apt-get install lxde-core lxterminal
```

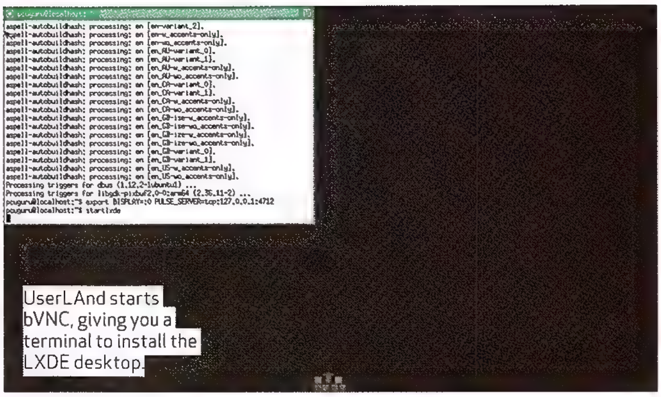
It's a 200MB download and requires 812MB of storage, which actually isn't too bad given what else is available. Download time depends on your network connection.

SETTING UP THE X WINDOW SERVER

The bVNC app is useful for the basic terminal setup, but we recommend an X



Select VNC when UserLAnd asks you to choose a connection type



```
aspell-autobuildhash: processing: en [en-variant_2].
aspell-autobuildhash: processing: en [en-w_accents-only].
aspell-autobuildhash: processing: en [en-wo_accents-only].
aspell-autobuildhash: processing: en [en_AU-variant_0].
aspell-autobuildhash: processing: en [en_AU-variant_1].
aspell-autobuildhash: processing: en [en_AU-w_accents-only].
aspell-autobuildhash: processing: en [en_AU-wo_accents-only].
aspell-autobuildhash: processing: en [en_CA-variant_0].
aspell-autobuildhash: processing: en [en_CA-variant_1].
aspell-autobuildhash: processing: en [en_CA-w_accents-only].
aspell-autobuildhash: processing: en [en_CA-wo_accents-only].
aspell-autobuildhash: processing: en [en_GB-ise-w_accents-only].
aspell-autobuildhash: processing: en [en_GB-ise-wo_accents-only].
aspell-autobuildhash: processing: en [en_GB-ize-w_accents-only].
aspell-autobuildhash: processing: en [en_GB-ize-wo_accents-only].
aspell-autobuildhash: processing: en [en_GB-variant_0].
aspell-autobuildhash: processing: en [en_GB-variant_1].
aspell-autobuildhash: processing: en [en_US-w_accents-only].
aspell-autobuildhash: processing: en [en_US-wo_accents-only].
Processing triggers for dbus (1.12.2-1ubuntu1) ...
Processing triggers for libgdk-pixbuf2.0-0:arm64 (2.36.11-2) ...
pcuguru@localhost:~$ export DISPLAY=:0 PULSE_SERVER=tcp:127.0.0.1:4712
pcuguru@localhost:~$ startlxde
```

UserLAnd starts bVNC, giving you a terminal to install the LXDE desktop

Windows Server. This is the method most Linux desktops use and for Android, XServer XSDL is our choice. Once the above apt-get installs are complete, launch XServer XSDL, just allow it to setup itself and eventually you'll get a blue screen with some code details. The code you need is:

```
export DISPLAY=:0 PULSE_
SERVER=tcp:127.0.0.1:4712
```

Type this codeline into the bVNC terminal and press Enter, followed by:

```
startlxde
```

and press Enter again. This launches the LXDE desktop session. However, you won't see any change on-screen until you go back and launch the XServer XSDL app again. After a few seconds, it should begin showing the makings of the LXDE desktop environment.

BLUETOOTH KEYBOARD/MOUSE

If you haven't already, setting up a Bluetooth keyboard and mouse would be a great idea right about now. Even the Lenovo Tab 7 Essentials tablet happily pairs both devices at once, so you shouldn't have any trouble. Just use Android's Bluetooth device setup procedure and device control will automatically pipe through to Ubuntu.

ACCESSING ANDROID STORAGE

Another nice feature (although it'll likely raise eyebrows from a security viewpoint) is the fact that the two systems are not totally isolated. You can access your Android storage and files via Ubuntu using the PCManFM file manager. From the LXDE menu, select 'System Tools', 'File Manager PCManFM' and it'll launch to your /home/<username> folder. At top-left, click the green up-level arrow until you get back to the root '/' folder. Open up the '/sdcard' folder and there are your Android folders.

WHAT YOU GET AND DON'T GET

Now in terms of apps, what you've got at this point is an ultra-lean Ubuntu 18.04.1 LTS desktop setup, with just a handful of peripheral-function apps installed. However, fire up lxterminal and you have access to the full Ubuntu ARM-class app repository, thanks to the 'apt' command-line tool. You'll find LibreOffice works well, as do lighter options such as GNUmeric (spreadsheet) and Abiword (word processor). You can code using Python 3.6 and IDLE, even run Audacity, giving you a full digital audio workstation.

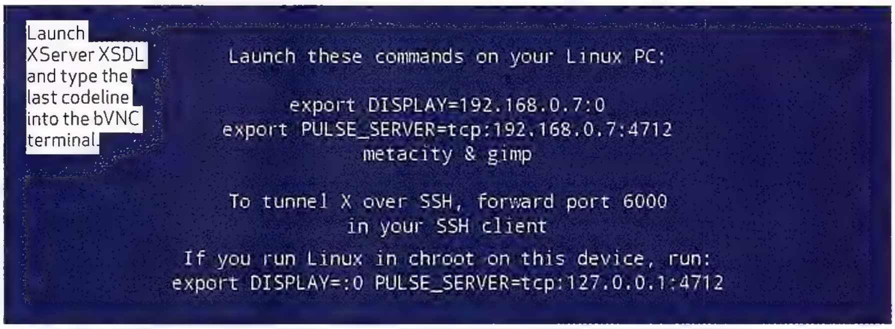
However, as good as this technique is, what you don't get is access to the device's 3D graphics hardware. Unfortunately, that means no 3D gaming, but more significantly, no web browser. That said, you still have access to your Android device's web browser, so it's not exactly a game-breaker. Download files using the Android web browser and access them in Ubuntu using the file manager in the /sdcard folder.

DELETING UBUNTU

If you decide to get rid of Ubuntu at some point, uninstall those three initial apps from your Android device – UserLAnd, bVNC and XServer XSDL – and it's all gone. The Linux root filesystem itself is stored by UserLAnd, so uninstalling UserLAnd may take a bit longer, but doing so returns your device to its original pre-Ubuntu setup.

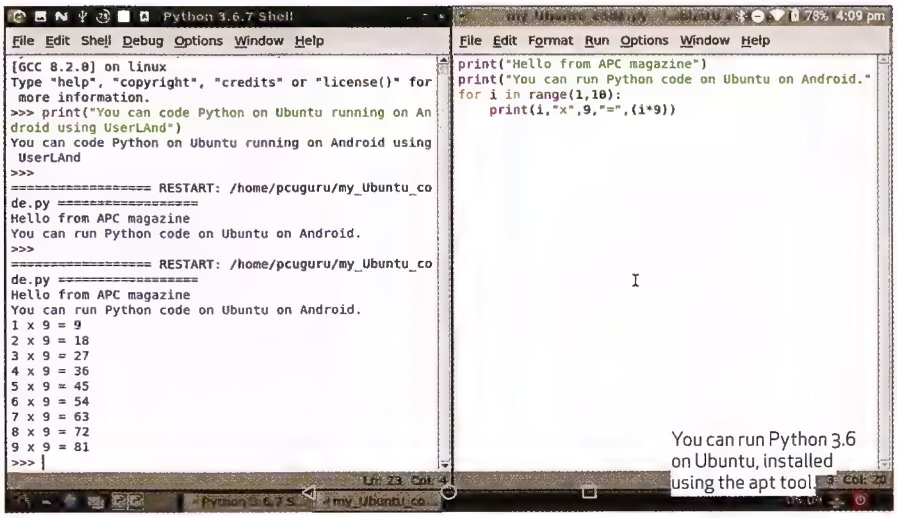
LINUX ON ANDROID? ABSOLUTELY!

Running a Linux desktop on an Android device might sound daft, but I've already found it extremely useful. Even on a budget tablet, the performance is surprisingly good and although you don't get a web browser or 3D gaming, there are plenty of productivity apps available on the Ubuntu repository to make it worth the effort. And, the whole thing runs as an Android app, so your Android OS remains intact. Great! ■



```
Launch these commands on your Linux PC:

export DISPLAY=192.168.0.7:0
export PULSE_SERVER=tcp:192.168.0.7:4712
metacity & gimp

To tunnel X over SSH, forward port 6000
in your SSH client

If you run Linux in chroot on this device, run:
export DISPLAY=:0 PULSE_SERVER=tcp:127.0.0.1:4712
```

Launch XServer XSDL and type the last codeline into the bVNC terminal


Python 3.6.7 Shell
File Edit Shell Debug Options Window Help
Ln: 23 Col: 4
Python 3.6.7 S...
my_Ubuntu_co...
File Edit Format Run Options Window Help
78% 4:09 pm
Col: 20

```
[GCC 8.2.0] on linux
Type "help", "copyright", "credits" or "license()" for
 more information.
>>> print("You can code Python on Ubuntu running on An
droid using UserLAnd")
You can code Python on Ubuntu running on Android using
 UserLAnd
>>>
================== RESTART: /home/pcuguru/my_Ubuntu_co
de.py ==================
Hello from APC magazine
You can run Python code on Ubuntu on Android.
>>>
================== RESTART: /home/pcuguru/my_Ubuntu_co
de.py ==================
Hello from APC magazine
You can run Python code on Ubuntu on Android.
1 x 9 = 9
2 x 9 = 18
3 x 9 = 27
4 x 9 = 36
5 x 9 = 45
6 x 9 = 54
7 x 9 = 63
8 x 9 = 72
9 x 9 = 81
>>> |
```

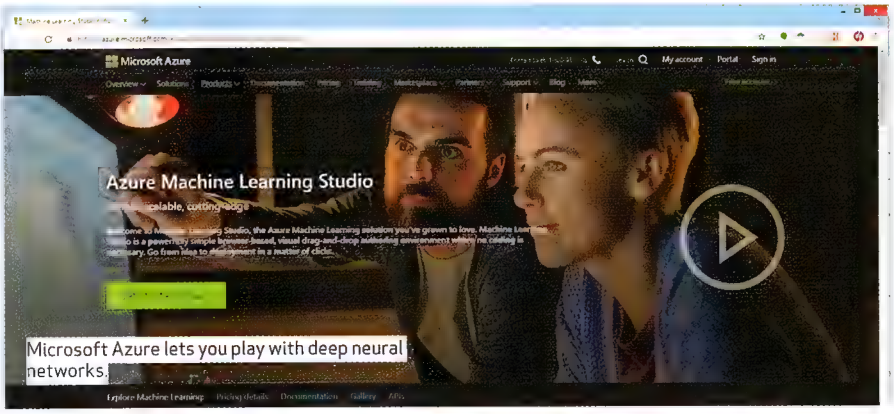
```
print("Hello from APC magazine")
print("You can run Python code on Ubuntu on Android.")
for i in range(1,10):
    print(i,"x",9,"=",(i*9))
```

You can run Python 3.6 on Ubuntu, installed using the apt tool

Making computer vision more accurate

Computers don't always need more pixels to see, but they can always use more learning. **Darren Yates** continues his quick dive into 'deep learning' on computer vision.

Last month, we introduced the concept of 'deep learning' using neural networks. It's one of the hottest technologies right now, even if you haven't heard a lot about it. For example, Google offers neural networks using its TensorFlow service (**tensorflow.org**), Microsoft similarly via Azure cloud compute (**tinyurl.com/yc9jycas**). Neural networks are the backbone of DeepFace, the facial recognition tech developed by Facebook and Netflix uses them to generate your 'what to watch next' lists via tools like VectorFlow. Neural networks are the rock-stars of machine-learning at the moment and chances are you're using them (or their results) without knowing it. We showed you last time how to build a simple neural network model to recognise hand-written digits 0 to 9 in a series of digital images. We also took part in a Kaggle competition to test our neural network model against thousands of other teams. This month, we're delving deeper into deep learning by looking at how we can improve our image recognition accuracy.



Microsoft Azure lets you play with deep neural networks.

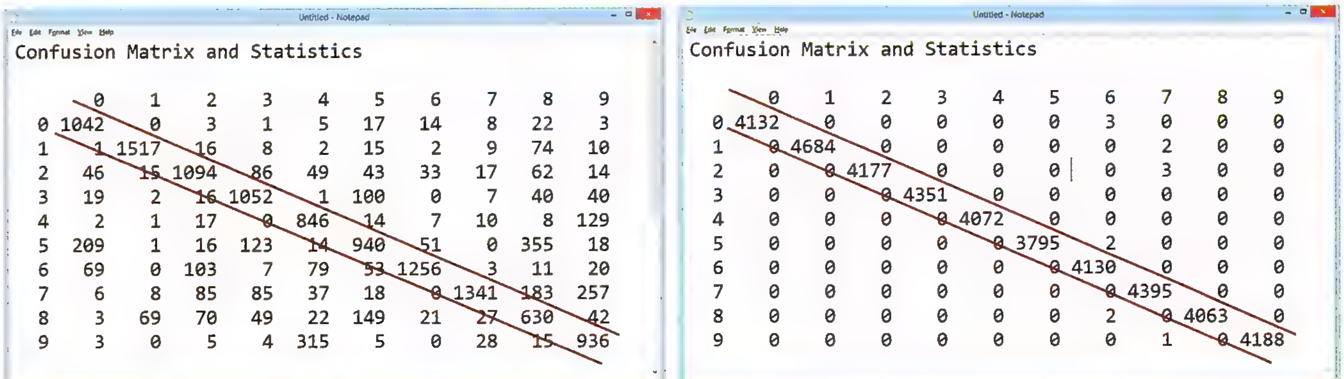
GET THE SOFTWARE

If you're new to this series, make sure you grab the software – you need the R programming language (get it free from the CSIRO's CRAN website at **cran.csiro.au**) and RStudio Desktop (a free open-source development environment from **rstudio.com/products/rstudio-desktop**). You'll also need our source code, which you'll find at **apcmag.com/magstuff**. Install the R language from CRAN before you install RStudio, then launch RStudio, select 'Open File' and load in the 'r_mnist_v1.r' source file from our *APC* download. Before running the source code the first time, you'll likely need to install a couple of libraries. You do this by typing the following commands into the console window underneath the source code editor:

```
install.packages('nnet')
install.packages('caret')
```

You'll also need the Digit Recognizer data from **kaggle.com/c/digit-recognizer/data** (select 'Download All' half-way down the page on the right, but sign up first – it's free). Unzip it, note the location and update the source code with the location. To run

> "we know that neural networks are a series of linked 'neurons', mathematical equations that apply a weight value to an input value to determine its importance."



```
Confusion Matrix and Statistics

     0    1    2    3    4    5    6    7    8    9
0 1042    0    3    1    5   17   14    8   22    3
1    1 1517   16    8    2   15    2    9   74   10
2   46   15 1094   86   49   43   33   17   62   14
3   19    2   16 1052    1  100    0    7   40   40
4    2    1   17    0  846   14    7   10    8  129
5  209    1   16  123   14  940   51    0  355   18
6   69    0  103    7   79   53 1256    3   11   20
7    6    8   85   85   37   18    0 1341  183  257
8    3   69   70   49   22  149   21   27  630   42
9    3    0    5    4  315    5    0   28   15  936
```

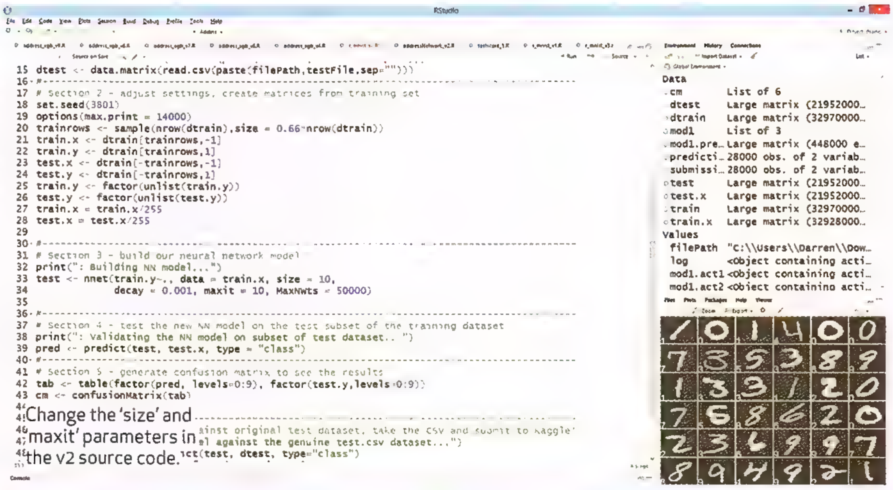
Original 'nnet' model

```
Confusion Matrix and Statistics

     0    1    2    3    4    5    6    7    8    9
0 4132    0    0    0    0    0    3    0    0    0
1    0 4684    0    0    0    0    0    2    0    0
2    0    0 4177    0    0    0    0    3    0    0
3    0    0    0 4351    0    0    0    0    0    0
4    0    0    0    0 4072    0    0    0    0    0
5    0    0    0    0    0 3795    2    0    0    0
6    0    0    0    0    0    0 4130    0    0    0
7    0    0    0    0    0    0    0 4395    0    0
8    0    0    0    0    0    0    2    0 4063    0
9    0    0    0    0    0    0    0    1    0 4188
```

New 'MXNet' model

The confusion matrix shows the improvement in recognition accuracy.

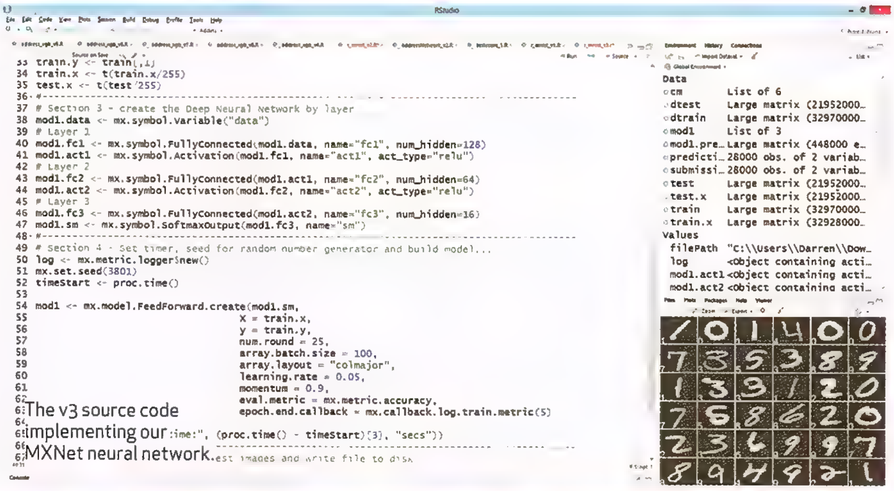
the code, press the 'Source' button on the right-side top of the source code text editor panel. The results will appear in the console panel underneath.



```
dtest <- data.matrix(read.csv(paste(filePath,testFile,sep="")))
#-----------------------------------------------------------------------------
# Section 2 - adjust settings, create matrices from training set
set.seed(3801)
options(max.print = 14000)
trainrows <- sample(nrow(dtrain),size = 0.66*nrow(dtrain))
train.x <- dtrain[trainrows,-1]
train.y <- dtrain[trainrows,1]
test.x <- dtrain[-trainrows,-1]
test.y <- dtrain[-trainrows,1]
train.y <- factor(unlist(train.y))
test.y <- factor(unlist(test.y))
train.x = train.x/255
test.x = test.x/255

#-----------------------------------------------------------------------------
# Section 3 - build our neural network model
print(": Building NN model...")
test <- nnet(train.y~., data = train.x, size = 10,
             decay = 0.001, maxit = 10, MaxNWts = 50000)

#-----------------------------------------------------------------------------
# Section 4 - test the new NN model on the test subset of the training dataset
print(": Validating the NN model on subset of test dataset.. ")
pred <- predict(test, test.x, type = "class")
#-----------------------------------------------------------------------------
# Section 5 - generate confusion matrix to see the results
tab <- table(factor(pred, levels=0:9), factor(test.y,levels=0:9))
cm <- confusionMatrix(tab)

                  -------------------------------------------------------
                  ainst original test dataset, take the CSV and submit to Kaggle'
                  el against the genuine test.csv dataset...")
                  ict(test, dtest, type="class")
```

```
Data
 cm          List of 6
 dtest       Large matrix (21952000…
 dtrain      Large matrix (32970000…
 mod1        List of 3
 mod1.pre…   Large matrix (448000 e…
 predicti…   28000 obs. of 2 variab…
 submissi…   28000 obs. of 2 variab…
 test        Large matrix (21952000…
 test.x      Large matrix (21952000…
 train       Large matrix (32970000…
 train.x     Large matrix (32928000…
Values
 filePath    "C:\\Users\\Darren\\Dow…
 log         <Object containing acti…
 mod1.act1   <Object containing acti…
 mod1.act2   <Object containing acti…
```

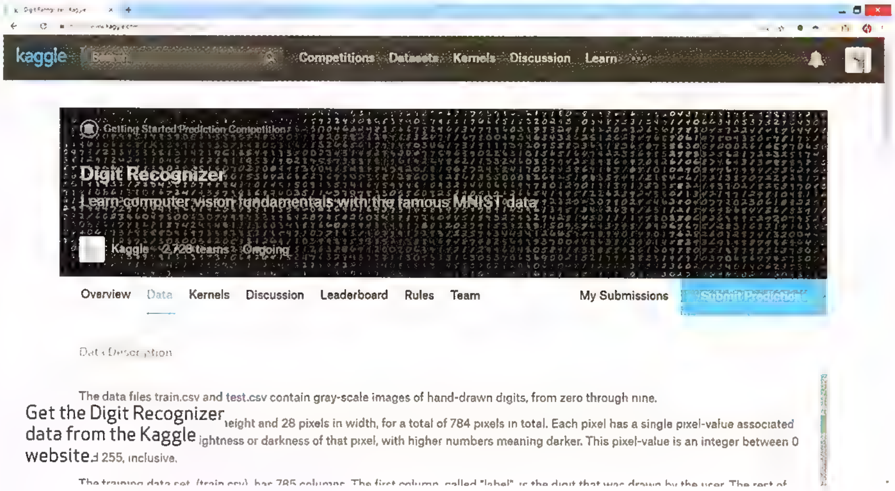
Change the 'size' and 'maxit' parameters in the v2 source code.



```
train.y <- train[,1]
train.x <- t(train.x/255)
test.x <- t(test/255)
#-----------------------------------------------------------------------------
# Section 3 - create the Deep Neural Network by layer
mod1.data <- mx.symbol.Variable("data")
# Layer 1
mod1.fc1 <- mx.symbol.FullyConnected(mod1.data, name="fc1", num_hidden=128)
mod1.act1 <- mx.symbol.Activation(mod1.fc1, name="act1", act_type="relu")
# Layer 2
mod1.fc2 <- mx.symbol.FullyConnected(mod1.act1, name="fc2", num_hidden=64)
mod1.act2 <- mx.symbol.Activation(mod1.fc2, name="act2", act_type="relu")
# Layer 3
mod1.fc3 <- mx.symbol.FullyConnected(mod1.act2, name="fc3", num_hidden=16)
mod1.sm <- mx.symbol.SoftmaxOutput(mod1.fc3, name="sm")
#-----------------------------------------------------------------------------
# Section 4 - Set timer, seed for random number generator and build model...
log <- mx.metric.logger$new()
mx.set.seed(3801)
timeStart <- proc.time()

mod1 <- mx.model.FeedForward.create(mod1.sm,
                                    X = train.x,
                                    y = train.y,
                                    num.round = 25,
                                    array.batch.size = 100,
                                    array.layout = "colmajor",
                                    learning.rate = 0.05,
                                    momentum = 0.9,
                                    eval.metric = mx.metric.accuracy,
                                    epoch.end.callback = mx.callback.log.train.metric(5)

                  ime:", (proc.time() - timeStart)[3], "secs"))
                  -------------------------------------------------------
                  est images and write file to disk
```

```
Data
 cm          List of 6
 dtest       Large matrix (21952000…
 dtrain      Large matrix (32970000…
 mod1        List of 3
 mod1.pre…   Large matrix (448000 e…
 predicti…   28000 obs. of 2 variab…
 submissi…   28000 obs. of 2 variab…
 test        Large matrix (21952000…
 test.x      Large matrix (21952000…
 train       Large matrix (32970000…
 train.x     Large matrix (32928000…
Values
 filePath    "C:\\Users\\Darren\\Dow…
 log         <Object containing acti…
 mod1.act1   <Object containing acti…
 mod1.act2   <Object containing acti…
```

The v3 source code implementing our MXNet neural network.



Digit Recognizer

Learn computer vision fundamentals with the famous MNIST data

Kaggle · 2,728 teams · Ongoing

Data Description

The data files train.csv and test.csv contain gray-scale images of hand-drawn digits, from zero through nine.

eight and 28 pixels in width, for a total of 784 pixels in total. Each pixel has a single pixel-value associated ightness or darkness of that pixel, with higher numbers meaning darker. This pixel-value is an integer between 0 d 255, inclusive.

Get the Digit Recognizer data from the Kaggle website.

ZERO FINESSE

Our initial neural network code achieved a Kaggle score of 0.74728 – on a range of zero to one, that's not too bad, until you find out that we ranked a lowly 2,622nd out of 2,718. But that was kind-of the idea – to create a starting point for looking at how neural networks work and what you need to consider for achieving maximum accuracy.

Just briefly, our original task was to create a machine-learning set of rules or 'model' that recognised the digits '0' to '9' from 42,000 training images and then test that model to identify the digits in a further 28,000 test images where the digit value is unknown. In our code from last month, we didn't do much more than load the 'nnet' neural network library, load the training data, point the 'nnet' library at the data and hit the 'Go' button. In other words, we showed all the finesse of a bull in a china shop.

NORMALISE YOUR INPUTS

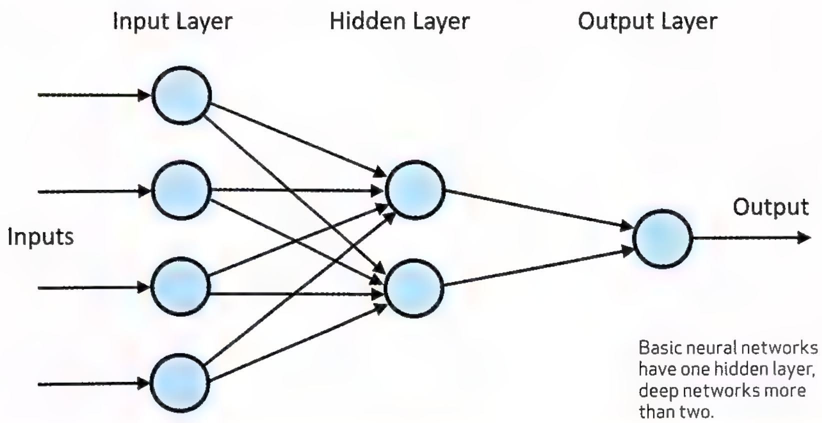
From last month, we know that neural networks are a series of linked 'neurons', mathematical equations that apply a weight value to an input value to determine its importance. We had the example of choosing between an Apple iPhone XS Max or a Google Pixel 3 XL phone using various features, such as screen size, battery life and price, as inputs, but weighted according to their importance to us.

In that example, we didn't use the raw values of screen size, battery life or price – we simply declared that if the Pixel 3 XL achieved the better result, the input would be a '1' and if it was the XS Max, it'd be a '0'. So, instead of having screen sizes in inches, or price in dollars or battery life in hours, we 'normalised' the input data to a scale of 0 to 1. This normalisation process is important for neural networks because it ensures that you don't have one input dominate another simply because of its larger values. For example, say you're buying a car and two key inputs are the number of gears in the gearbox and the price. The price range might go up to $40,000, but you'll likely have no more than six gears. Without normalisation, the range of the price input could swamp that of the gear input just on the basis that 40,000 is way larger than six.

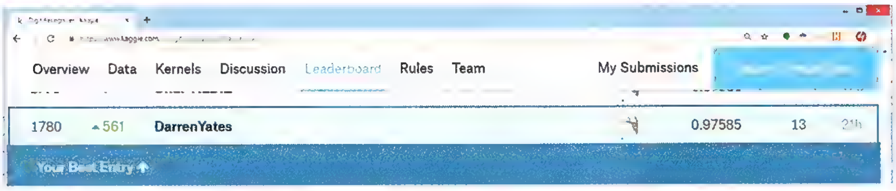
To bring everything back to a level playing field, we normalise the inputs so that they all work in a range of 0 to 1. Our 42,000 training images in this example are 28x28-pixels, but they've been converted to a spreadsheet row of 784 columns. Each cell in that row represents the 8-bit greyscale value of one pixel in that image. Since the maximum 8-bit value is 255, we use R to divide each cell by 255, converting each one back to our desired range of 0 to 1.

Our original code had an identification accuracy on the training data of 0.7461 (74.61%). Just through normalising the input values (dividing them by 255), we boost that accuracy to 0.8824 (88.24%).

In machine-learning, that's a sizeable improvement – there are few tricks this simple that can gain you an extra 14% accuracy. We can't guarantee it'll make a huge difference in every application, but normalising your inputs should almost be done as a matter of course.

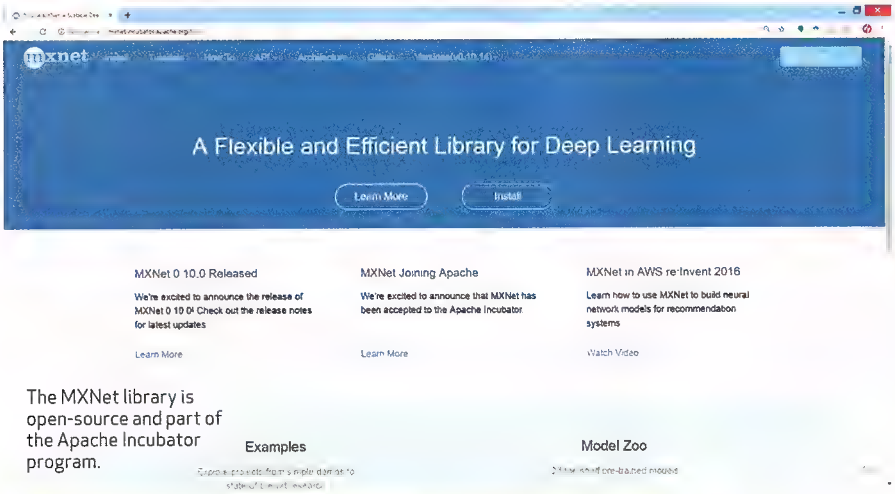


Basic neural networks have one hidden layer, deep networks more than two.



1780 ▲561 DarrenYates 0.97585 13 21h

Our MXNet model pushed us up to a 0.97585 score on the Kaggle leaderboard.



A Flexible and Efficient Library for Deep Learning

MXNet 0 10.0 Released

We're excited to announce the release of MXNet 0 10 0! Check out the release notes for latest updates

MXNet Joining Apache

We're excited to announce that MXNet has been accepted to the Apache Incubator

MXNet in AWS re:Invent 2016

Learn how to use MXNet to build neural network models for recommendation systems

Examples

Model Zoo

The MXNet library is open-source and part of the Apache Incubator program.

> "Deep neural networks can learn incredibly complex patterns and it's no wonder the technology is being used in many and varied applications."

SETTING NNET PARAMETERS

Another thing we can do is tweak the parameters of the neural network library itself. The 'nnet' library has a number of parameters to adjust its performance, a key option being the 'maxit' (maximum iteration) parameter. Neural networks are slow machine-learners and improve their learning slowly on each run or 'iteration'. Load in the 'r_mnist_v2.r' source code file, set the 'maxit' parameter on line 34 to '2', run the code and you'll get an accuracy of just 0.1377 (13.77%). Set it to '10' and it improves markedly to 0.6461 (64.61%). It's not unheard-of to run through hundreds of iterations, but more isn't always better – more iterations take more time, but the model could also become so attuned to the training data that it's 'overfitted'. That means when you feed the model with previously-unseen data, it won't handle it as well as a more generalised model would. Moreover, a poorly configured model run 500 times could easily give you less accuracy than a well-setup model run just 50 times.

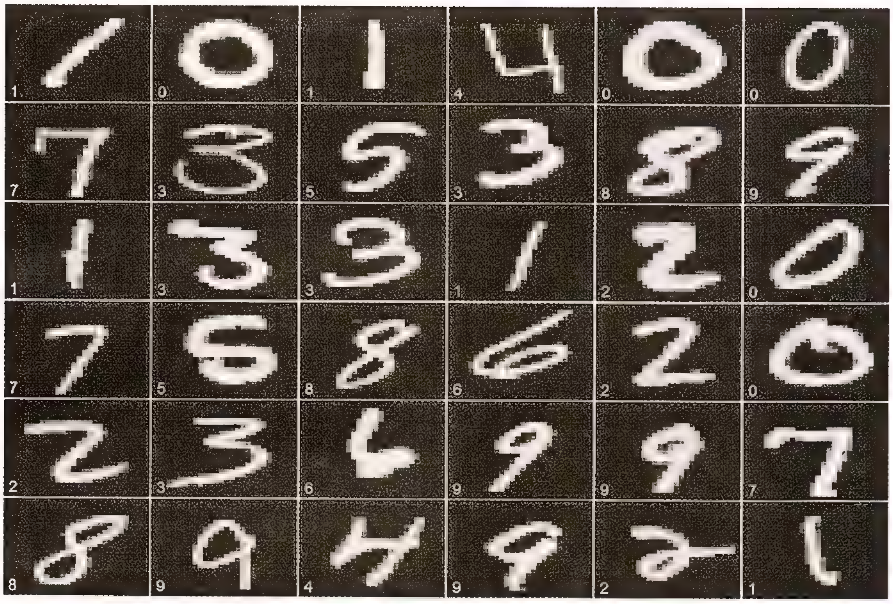
As an exercise, we ran 'nnet' over our normalised data for 200 iterations and achieved an accuracy of 0.8724 (87.24%), so not only did we go slightly backwards in accuracy in this case, but it also took longer to run. You want to balance the number of iterations against the 'learning rate' or 'learning decay rate'. The faster you set this rate, the fewer iterations you may need, but also the more likely your network will overshoot the optimum result.

Another option is increasing the size of the hidden layer. Just briefly, a basic neural network consists of three layers of neurons – the input layer (one neuron for each input), a hidden layer (as many neurons as you like) and the output layer (one neuron for each output required). The rough rule-of-thumb for selecting the number of neurons for the hidden layer is to have fewer than the input layer, but more than the output layer. Since our input layer has 784 neurons and our output layer has only one, it leaves plenty of scope for choice. We've chosen to set the 'size' parameter in line 33 to '10' initially, but like setting the number of iterations, increasing the number of hidden layer neurons greatly increases the build time.

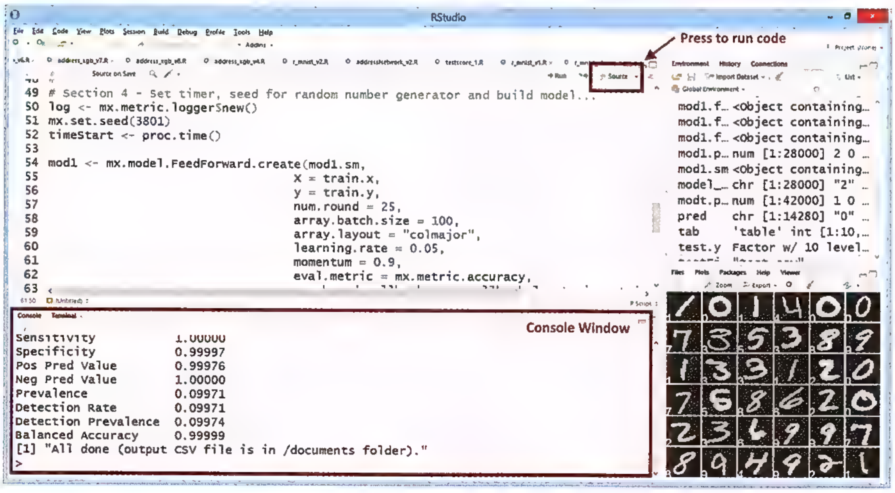
If we increase the 'size' parameter to 15 and keep the 'maxit' iteration count to 50, we actually boost accuracy to 0.9091 (90.91%). Remember, though, this is only testing the training data – we still don't know how the model will perform on the 28,000 test images and we won't know until we test those images and submit the results to Kaggle. This we did, and although we improved our accuracy score to 0.89300 (89.3%), we've only moved up the Kaggle 'Digit Recognizer' board about 60 positions.

GOING DEEPER

The 'nnet' library is a great little library, but it can only build standard 'feed-forward' neural networks with a single hidden layer. Now we did say last time that few applications require more than one hidden layer – this is one of the 'few'. To move up the rankings we need more power. MXNet is a powerful open-source deep learning library supported by the Apache Software Foundation. Fire up RStudio and load the 'r_mnist_v3.r' source file. We've borrowed from a couple of sources for our code here, namely the Apache MXNet documentation (**tinyurl.com/ya66w6o7**) and a Kaggle kernel by user 'TheTS' (**tinyurl.com/y9eczaxs**).



The first 36 handwritten digit i mages with their class value in the left corner.


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Source on Save
Run
Source
Press to run code
Environment History Connections
Import Dataset
Global Environment
Files Plots Packages Help Viewer
Zoom Export
Console Terminal
Console Window

```
# Section 4 - Set timer, seed for random number generator and build model...
log <- mx.metric.loggerSnew()
mx.set.seed(3801)
timeStart <- proc.time()

mod1 <- mx.model.FeedForward.create(mod1.sm,
                                    X = train.x,
                                    y = train.y,
                                    num.round = 25,
                                    array.batch.size = 100,
                                    array.layout = "colmajor",
                                    learning.rate = 0.05,
                                    momentum = 0.9,
                                    eval.metric = mx.metric.accuracy,
```

```
mod1.f… <Object containing…
mod1.f… <Object containing…
mod1.f… <Object containing…
mod1.p… num [1:28000] 2 0 …
mod1.sm <Object containing…
model_… chr [1:28000] "2" …
modt.p… num [1:42000] 1 0 …
pred    chr [1:14280] "0" …
tab     'table' int [1:10,…
test.y  Factor w/ 10 level…
```

```
Sensitivity          1.00000
Specificity          0.99997
Pos Pred Value       0.99976
Neg Pred Value       1.00000
Prevalence           0.09971
Detection Rate       0.09971
Detection Prevalence 0.09974
Balanced Accuracy    0.99999
[1] "All done (output CSV file is in /documents folder)."
>
```

Use the 'source' button on the top-right to launch code in RStudio Desktop.

INSTALLING MXNET

The MXNet library is not part of the Comprehensive R Archive Network or 'CRAN', so you need to install the library package before you run the v3 source code. To do this, run these commands in the RStudio console command prompt:

```
  cran <- getOptions(“repos”)
  cran[“dmlc”] <- “https://
s3-us-west-2.amazonaws.com/
apache-mxnet/R/CRAN/”
options(repos = cran)
  install.packages(“mxnet”)
```

Once installed, you can now run the 'r_mnist_v3.r' source code via the 'source' button at the top-right of the source code text editor. Pretty quickly, you should see the recognition accuracy of the 42,000 training images reaches 0.9995 (99.95%). It won't quite reach the same level on Kaggle with the 28,000 test images, but should still be significantly better than we achieved using the 'nnet' model. In fact, it was – on submitting the results to Kaggle, we scored 0.97585 (97.585%), pushing us up at the time to 1,781th position.

HOW IT WORKS

MXNet allows you to build what's called a 'deep neural network', which in our example is a feed-forward neural network with multiple hidden layers. Look at the 'r_mnist_v3.r' source code in Section 4 and you'll see our network model has three hidden layers, each with progressively fewer neurons. It's still a 'feed forward' network, where the information flow is from input to output only, but the extra layers allow for greater learning, hence the higher recognition accuracy.

Section 5 of the source code is where the neural network is trained on the training data and the various parameters here allow you to tune the model, particularly the number of iteration (num.round), the learning rate (learning.rate) and the array batch size (array.batch.size). Run the model through enough iterations and it will perfectly learn the training data with no errors – but remember the overfitting issue means it'll almost definitely be less accurate with the test data.

MXNet will also let you build a more complex type of network called a 'convolutional neural network' (CNN). CNNs are typically used in image recognition, but their complexity is beyond the scope of what we have room for here.

If you're interested, follow the link above to the Kaggle kernel by user 'TheTS'. For what it's worth, the highest scores on the Kaggle 'Digit Recognizer' scoreboard often come from well-tuned convolutional neural networks, where accuracies of beyond 0.99 are common.

GOOD LEARNING

We haven't cracked the 'top 1,000' on the Kaggle leaderboard for this competition, but we have improved our recognition accuracy from 74% to well over 97%. That's not a bad effort. Tweaking the parameters of the model creation process will vary the build time and accuracy – try varying them by small amounts yourself and see how you go.

Deep neural networks can learn incredibly complex patterns and it's no wonder the technology is being used in many and varied applications. However, the model created is pretty much a 'black box', meaning you can't peer inside it easily and understand what has been learned, since it's more or less a mash-up of mathematical equations.

In data science, the goal for machine-learning is typically what's called 'knowledge discovery' – to identify patterns within the data that can be actioned, whether it's in business, in medical research, sports science or whatever. This is where decision trees and more transparent rule mining techniques can often be more effective. It's also why it's important to understand different machine-learning techniques, because there's no one method that's perfect for every application – at least not yet.

MACHINE-LEARNING WITH PYTHON

Beginning next month, we're launching a new series on machine-learning in Python within the pages of *APC*, so that's something to look forward to! We'll cover the basics of coding in the world's most popular programming language and we'll show you how to use it to execute a range of machine-learning tasks. As always, it'll be a very practical hands-on guide, so don't miss it! ■

downtime

GAME NEWS IS SERIOUS NEWS.

Mortal Kombat 11 is bloody, violent, and launching April 23

MORTAL KOMBAT 11 RELEASE DATE REVEALED AT THE GAME AWARDS 2018

A surprise reveal from The Game Awards 2018: *Mortal Kombat 11* is not only coming, but it's practically just around the corner, with a special community reveal on January 17, and a global launch on April 23.

With the trailer showing off two Scorpions, one of which is wearing his classic costume, plus the tease at the end with a mysterious woman caressing a giant hourglass, it would seem there are some time travel shenanigans afoot once again. And of course, the fighting looks just as brutal – if not more so – than any previous entry in the franchise.

Steam cuts support for Windows XP and Vista

IT'S TIME TO UPDATE ALREADY.

Since January 1, behemoth games storefront Steam will no longer actively support customers using Windows XP and Vista. Due to a client update reliant on Google Chrome, the desktop app will no longer work on those old operating systems. If you're still running those OSs and want to use Steam, Valve suggests updating to a more recent version of Windows.

Nvidia cards now support Freesync

HELL HATH FROZEN OVER.

During Nvidia's CES keynote, CEO Jensen Huang announced that Freesync ('Adaptive Sync' in open source lingo) monitors would henceforth be compatible with Nvidia GPUs to allow a variable refresh rate. The caveat? Of the 400 Freesync monitors tested by Nvidia so far, just 12 worked without issues. These 12 – and any future monitors that pass Nvidia's verification process – will be supported by updates to the Nvidia driver package.

Epic is giving away Fortnite tech so more games can have cross-platform multiplayer

Epic unveils plans to support developers via free multiplayer services.

A week after opening its own digital storefront with a generous revenue share model clearly intended to compete with Steam, today *Fortnite* creator Epic Games announced plans to support cross-platform multiplayer across all games by making *Fortnite's* cross-platform services free to all developers.

"These services are expensive to build, test and harden in real-world conditions, but once operational, are relatively inexpensive to scale to more games and more users," Epic said. To streamline this process and make cross-platform play more accessible for other studios and games, Epic says that "throughout 2019, we'll be launching a large set of cross-platform game services originally built for *Fortnite*, and battle-tested with 200,000,000 players across seven platforms."

Epic says these services will be free for all developers and will not be limited to games made using its Unreal Engine or those sold via its new Epic Game Store. Developers will be "free to choose mix-and-match solutions from Epic and others," the announcement reads.

This cross-platform plan will roll out over the course of 2019.

> "These services are expensive to build, test and harden in real-world conditions, but once operational, are relatively inexpensive to scale to more games and more users."

Monster Hunter: World G rank Iceborne expansion announced

A new quest difficulty, new monsters, and at least one fan-favorite monster are on the way.

A large *Monster Hunter: World* expansion called Iceborne is coming in autumn 2019 (on console, with the PC release coming later), Capcom announced last month. *Iceborne* will add a higher quest rank analogous to the G rank difficulty of previous games, as well as new and returning monsters, a post-game story set in a chilly new biome, and a visit from *The Witcher 3's* Geralt.

Many *Monster Hunter: World* players have been clamoring for a G rank expansion for months, so it's undoubtedly the leading act in *Iceborne*. But Capcom says there's plenty more in store, including "new moves" which sound like they'll expand on existing weapon move sets – perhaps through unlockable finishers, or even *Monster Hunter Generations*-esque hunter arts? Apart from new monsters, we know *Iceborne* will also add at least one fan-favorite to *World's* roster; the catlike wyvern Nargacuga, originally introduced in *Monster Hunter Freedom Unite*, makes a brief appearance at the end of the trailer.

Iceborne is scheduled to release well into 2019, but Capcom also announced another, smaller update scheduled for early 2019: a *Witcher 3* collaboration featuring none other than Geralt of Rivia, who is presumably a longsword main. Quite frankly, we can't think of a more fitting crossover. Geralt is a trained monster hunter, after all.

Obsidian's new game The Outer Worlds looks like space age Fallout: New Vegas

THE ORIGINAL CREATORS OF FALLOUT ARE BACK WITH A NEW SCI-FI RPG.

The original creators of *Fallout* and the studio behind *Fallout: New Vegas* have revealed a new first-person RPG as part of The Game Awards 2018 – but don't expect another post-apocalyptic wasteland, because *The Outer Worlds* is a slick, space age adventure.

Obsidian gained a ton of goodwill and praise for its work on *New Vegas*, and I don't know about you, but I get some serious *NV* vibes from this teaser. That might just be the cobbled-together look of some of the game's armor and weapons, but in any case, we're excited.

But even if that game wasn't necessarily your thing, the game's emphasis on player choice, bleak humor, and a ragtag group of underdogs fighting against corruption look like a perfect mix of ingredients.

Fortnite streamer Ninja made nearly $10 million last year

THE BATTLE ROYALE PHENOMENON IS MAKING PEOPLE RICH.

Tyler 'Ninja' Blevins, a *Fornite* streamer who rose to mainstream fame in early 2018 thanks the appearance of rapper Drake on his channel, made nearly $10 million last year, according to *CNN*. According to Blevins, 70 percent of his income comes from YouTube and Twitch, while the rest is earned from sponsors including Red Bull and Samsung. He spent around 4,000 hours playing *Fortnite* in 2018.

Intel and ESL will pour $100m into esports over the next three years

VIDEO GAMES AREN'T ART, THEY'RE SPECTATOR SPORTS.

Few are the games-centric technology companies who have not sniffed money in esports, but Intel definitely ranks among the highest in terms of their willingness to invest. The company announced late last year that it is extending its global partnership with ESL, and in a joint announcement, they announced that they'll pour US$100 million into esports over the next three years.

The companies have been collaborating in a global capacity since 2006, when Intel sponsored the first Intel Extreme Masters. Since then, the *Counter-Strike* tournament has launched a high profile event in Sydney, with the third event scheduled to take place in Sydney this coming May.

It's no surprise that companies are ramping up their dollar investments in esports – games as a spectator sport hit a new mainstream benchmark this year with the news that a *Fortnite* streamer, Ninja, made nearly $10 million. In 2018, ESL claims it attracted "up to" 15,000 daily visitors across ten separate events. ■

$60 | PC, PS4, XO | WWW.CALLOFCTHULHU-GAME.COM

Call of Cthulhu

Ph'nglui mglw'nafh Cthulhu R'lyeh wgah'nagl fhtagn.

H.P. Lovecraft may have done most of his writing almost 100 years ago, but he casts a long shadow over contemporary arts. This particular stab at unknowable horror is based on the 1981 pen & paper RPG of the same name, and sees grizzled private investigator Edward, suffering from PTSD following wartime experiences, look into a strange fire and disappearances on an island off the coast of Massachusetts.

As a study in foreboding atmosphere, Call of Cthulhu hits all the right unsettling notes. Faces are craggy, all deep-set eyes and filthy scars, and a strong maritime theme gives an excuse for the beams of a lighthouse to rhythmically pierce the misty gloom.

While exploring, a tale of a botched police investigation into the death of a family unravels, with Edward's private investigator skills digging up clues, and his medical knowledge used to interpret them. As you gain experience, points are added to your skills, but some can only be increased by reading books or finding artifacts. Most objects have a glowing white dot to guide you to them, but some are hidden, and if your "find hidden" skill isn't high enough, the game won't even tell you they're there.

Edward can also reconstruct past scenes, figures manifesting as ghostly recreations of often violent events that help his investigation and give him insight into the motives of the present. It's not the kind of horror game that tries to make you jump in the dark, more the sort that leaves you with a sense of unease, and a feeling that you're not in control.

Unfortunately, once the opening is over, it lets itself down. A wonderful scene in a mental hospital, which follows a tense close encounter of the tentacled kind, is followed by a mix of simplistic puzzles and enforced stealth as you escape. It even reuses puzzle mechanics, having you following cables or pipes to their destinations, while avoiding the kind of goons who could surely be punched out of the way. Get caught and you're dead. It recycles enemies, too, and there's only one section in which you engage in combat.

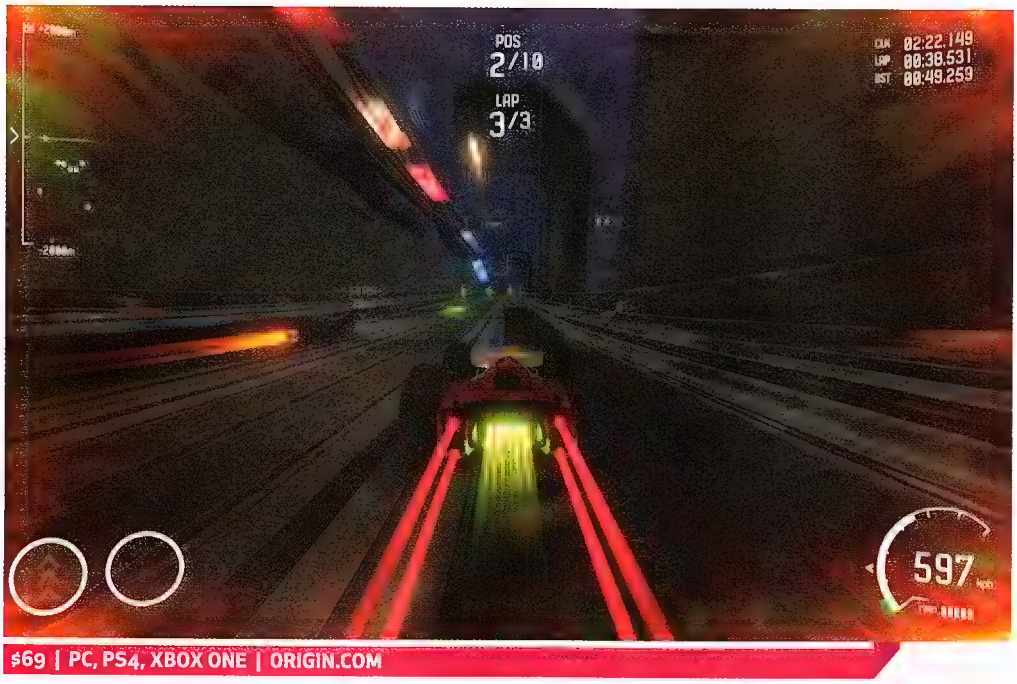
The feeling of helplessness in the face of unstoppable onslaught by creatures whose motives you can't understand might be Lovecraftian, but it's not great for videogames, where player agency is all. The paper RPG often left players dead or trapped in mental institutions, but here all you need to see the end credits is perseverance. Restarts are fast, and checkpoints sensibly placed, but sequences such as finding the right object in a room full of wrong ones before a monster gets you feel like trial and error, rather than tests of skill.

There have been several attempts to bring Lovecraft to the world of games, and this is one of the more successful. It's a horror game without the jump scares, and it brings a touch of the cosmic to small-town New England. ■ **Ian Evenden**

Verdict

Relentlessly disturbing atmosphere; great tale of cults and monsters; some really craggy faces.

★★★½☆



$69 | PC, PS4, XBOX ONE | ORIGIN.COM

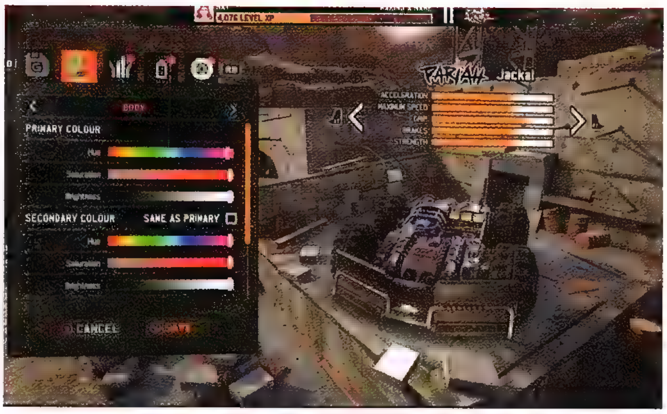
Grip: Combat Racing

Little more than a forgettable throwback.

This is a a throwback to the arcade-style racers that didn't stand the test of time. For Caged Element, it's 1999's *Rollcage* that's desperately needing a reboot two decades on, and that isn't exactly considered a classic today. *GRIP* is often able to evoke those better memories, as your four-wheeled machine tears through the side of a canyon to thumping drum-and-bass. But moments like this are scattered throughout a soulless, unpolished package.

The key here is that when going fast enough, cars will grip to any surface, leading to maps that flip from wall to ceiling to floor. It's often fantastic, and tumbling down one of *GRIP*'s many winding tunnels is great fun. But cars are too easily sent into dead ends. Maps feature many obstacles that stop players in their tracks, rather than leading them back on course. I have had to hit that restart button more often than not after a catastrophic crash.

GRIP's a looker in a certain sense, loaded with motion blur and dramatic lighting.



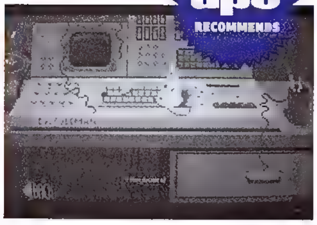
It's fine overall, but lacks detail or personality. We never see who's behind the wheel of these bonkers vehicles beyond faceless figures in cartoonishly drawn loading screens. Maps span a mix of biomes, but nothing you haven't seen before. Mountains, wastelands, forests, all scattered with sci-fi greebles. It's often exhilarating, if rarely inspiring, although the city maps fall flat as racers power down empty streets past featureless buildings.

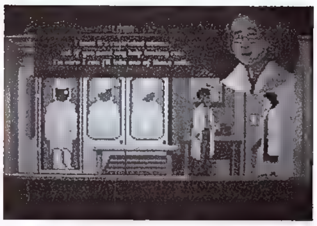
There's a lengthy campaign that unlocks new pickups, race types, vehicles and levels over time. It's plenty to keep coming back to, but it's all delivered so flatly. Combined with a janky UI, there's an overwhelming sense of cheapness. Still, it's fine if you're yearning for some arcadey racing. The Battle and Carkour (car parkour, get it?) modes are forgettable, but there's a competent variety of tracks and race modes to get your fill. *GRIP* simply needed to show that it could be more than a cover band performing a forgettable '90s track. ■ **Natalie Clayton**

Verdict

It's competent, but lacking in style and substance.

★★★☆☆





The Goodbye Note

Where things get weird.

FREE | PC
WWW.BIT.LY/GOODBYENOTE

Last year, talented pixel artist Octavi Navarro released their first game as a little Halloween freebie, and this year sees this title as a follow-up. The games are presented as entries in a Twilight Zone-style anthology series, and the second is slightly more ambitious, boasting a handful of locations, a more interesting story to chew upon, and a more emphatic gut punch waiting at the ending twist. The plot is pure B-movie, and wonderfully so, shrinking a Cold War-era sci-fi film down to a more compact 20-30 minutes, while adding a handful of puzzles to keep your brain engaged. The art, as you might expect from an artist who worked on *Thimbleweed Park*, is some of the best you'll find in any pixel art game: characterful, slightly cartoony, but still entirely fitting with the game's largely serious tone.

But it's that pointing, and of course that clicking, that has evolved the most since the original *Midnight Scenes*, which was too small in every way to really grapple with. This is a proper adventure game, with a few good puzzles and a story that takes you on a journey, as your desperate scientist tries his best to save mankind. ■ **Tom Sykes**

★★★★☆

September 1999

Sinister suburbs.

FREE | PC
WWW.BIT.LY/SEPT_199E

98demake's *September 1999* is the most unsettling 'found footage' experience I've come across in ages. Its uncannily domestic setting feels like a real place, albeit one you'll be desperate to get away from. Relying on a VHS camera filter to hearken back to the 90s look, this is the first I've encountered that feels more real because of it. The 3D models and textures that comprise this dingy suburban house are high quality, while any gaps in the uncanny valley have been filled in thanks to that hefty VHS smear.

Presented as an actual reel of tape, *September 1999* begins without any menu or introduction, but with the camera simply filming an empty room. Controlling that camera, you'll explore the house a tiny bit, as unsettling sounds suggest unsightly things just off in the distance, and as jarring jump cuts gradually bring the horror closer. There's an ending, which is as ambiguous as it is toe-curling, before the game suddenly cuts out, the tape unceremoniously switched off. ■

Tom Sykes

★★★★☆

$84 | PC, PS4, XO | WWW.HITMAN.COM

Hitman 2

Man compensates for lack of hair with weaponry.

A *Hitman* level isn't designed to be played just once. There's the initial explore, when you go in knowing just the intel you've been supplied with beforehand, and need to scope everything out. The locations of weapons, targets, and security cameras are still unknown, and it's quite possible that you'll need to restart before your target is cold.

Then there are the practice runs, when you know the layout, and are experimenting with murder methodology, graduating from simple suppressed gunshots to poison in drinks to elaborate creations involving gas pipes, overloaded valves, and fireworks. Later, you're playing it on a timer, trying to shave seconds off to knock your rival from the top of the leaderboard. By this point, you know the level inside out, counting under your breath as you wait around a corner for the exact number of heartbeats it takes for a guard to turn his back.

This is what sets *Hitman* apart from other games: It's meant to be repeated, to be perfected. *Hitman* isn't a third-person shooter or even really a stealth game, it's a Rube Goldberg machine, waiting for you to manipulate it. And it's for this reason that the previous game's release as a series of episodes made sense. Without the pull of the next level enticing you to speed up, you could spend a month patiently laying plans, and watching them pay off, then refining them on another run.

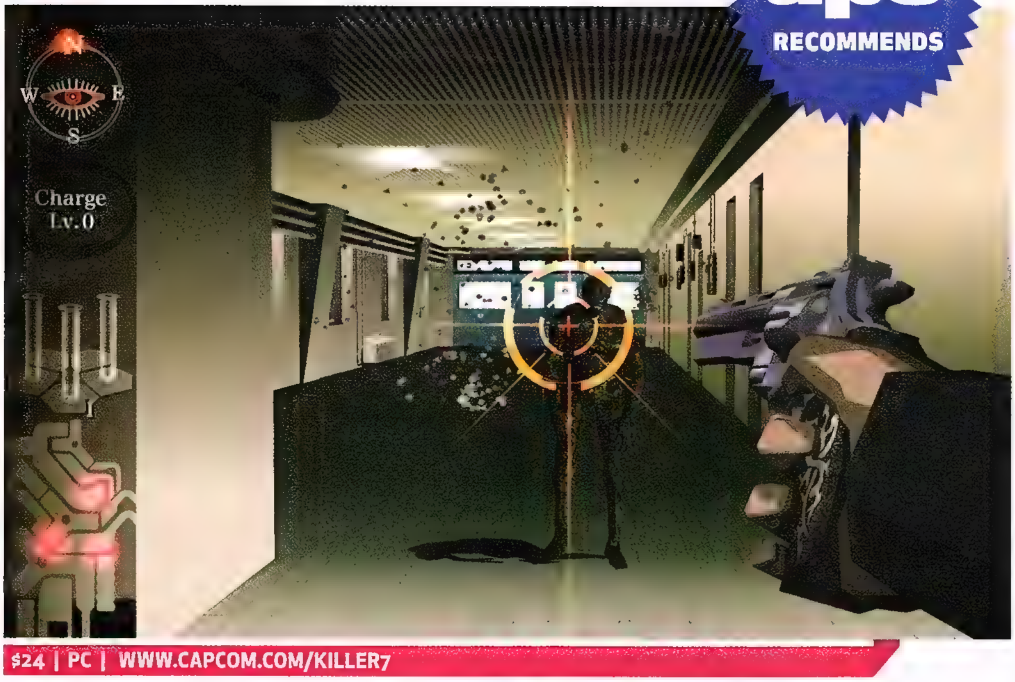
Hitman 2 gives you all its levels in one go, and you can even play them out of order. This is iteration rather than revolution, something further evidenced by the ability to play 2016 *Hitman* levels within the game. It's like a GOTY edition of that game, one that comes with all DLC. It's a novel approach, and one that will supply anyone who's not played the previous game with a bonanza of content. A lot of missions feel like riffs on those from previous games, so perhaps the devs are refining their approach to the game, too. ■ Ian Evenden

Verdict

Refined iteration of the previous game with new levels; complex and confident.

★★★★☆

apc RECOMMENDS



$24 | PC | WWW.CAPCOM.COM/KILLER7

Killer 7

A weird Japanese shooter that makes its own rules.

It's difficult to pin down exactly what *Killer7* is. It has first-person shooting, third-person exploration, Resident Evil-style puzzles and a selection of characters with unique abilities. But it combines these familiar ideas in a way that is totally original – and, often, utterly confounding.

The story in *Killer7* is labyrinthine and dreamlike, and prone to frequent, baffling tangents. But the general idea is that you are Harman Smith, an elderly man who uses a wheelchair. Smith is able to conjure up seven different personalities, each with their own particular skills in combat. Violence-loving Dan Smith is an ex-cop who wields a Dirty Harry-style revolver. Mask de Smith is a luchador who favours a pair of grenade launchers. Kaede Smith uses a scoped pistol and can reveal secrets by, er, cutting her wrists and bleeding on them. There are more to discover, but you get the idea.

One of the most curious design decisions in Killer7 is that there's no freedom of movement or camera controls. The action is viewed entirely from fixed, dramatic angles, and your exploration is limited to holding a button to walk forward, and hitting another to turn around. This odd, on-rails system takes some getting used to, and can feel quite restrictive at times.

But when you hear the eerie laughter heralding the arrival of an enemy, you pull out your weapon and switch to first-person, and are able to target them manually. You can't move while shooting, however, and many enemies have a habit of rushing you and exploding, which makes accuracy key.

This combat makes up the bulk of the game. There are characters to speak to, those aforementioned puzzles, and an upgrade system, but despite its novel presentation, *Killer7* is a rather simple shooter.

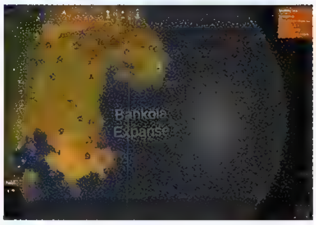
Give yourself to the game, adapt to its peculiar rhythm, and it's an experience like no other. The bold visuals, disturbing music and general oddness of the storyline and dialogue are hypnotic. It combines stark comic book violence, Lynchian strangeness, and Japanese design sensibilities to compelling effect. ■

Andy Kelly

Verdict

Imaginative, beautiful, and utterly strange.

★★★★☆



Rimworld

Doesn't quite reach the stars.

$49 | PC
WWW.RIMWORLDGAME.COM

RimWorld is a life sim about establishing a colony on a remote planet. Things go wrong, the unexpected occurs and your colonists react. Each colonist has drives and needs, ones that are often unhelpful to the mission but which are intended to make them more complex characters. Once you're down on the ground it's all a matter of laying out tasks for your colonists. You don't get to take control so must instead lay down blueprints and zones, and stack up tasks for them to complete. The real fun stuff occurs once you've got a competent colony built and can begin to watch your colonists deal with all manner of scenarios. Things become more complex and varied the longer a colony survives. Interesting things happen but when the characters already feel so artificial they rarely take on the life required to make me believe in the stories unfolding. I'm not watching a drama but a chaotic petri dish. Which isn't to say it doesn't have its moments or there isn't fun in its failure to tell engaging stories, but it doesn't live up to its promise. ■ **Sam Greer**

★★★½☆

Pressing circle next to the remains of a colossi in their lair after defeating them allows you to fight them again in a film-grain Reminiscence Mode.

DEVELOPER: TEAM ICO **PUBLISHER:** SONY **RELEASED:** 2005 **SYSTEM:** PS2

GAME CHANGER

Shadow Of The Colossus

This monumental game was a massive leap forward for game design, narrative style and structure. We reflect on the impact this giant of gaming history had on the industry.

We tend to spend a lot of time reflecting on and praising the spectacle of *Shadow Of The Colossus* as well as its narrative, design, and thematic choices, but perhaps we ought to consider the technical challenges and advancements it made too. When Fumito Ueda looked to follow up on *Ico*, he wasn't interested in making a direct sequel or repeating what he had done before. He looked to push the PS2 harder and create something that, for all of its scale and fantasy, was rooted in realism and maintained its illusion as much as possible. The mechanics and animations of the game needed to complement the immersion of the world as much as possible, and that wasn't easy.

The task was made all the more demanding (and the results all the more remarkable) with a team of just 35 artists and programmers working on *Shadow Of The Colossus*. This was a lot more people than worked on *Ico*, we should mention, but still a rather small team by modern standards. Given the scale of the game world, not to mention the scale of the colossi, it's really quite incredible how much it managed to achieve with so limited a team, albeit with plenty of development time between projects to make it all happen.

The technical challenges of *Shadow Of The Colossus* were numerous and really quite specific to the unique features the experience finally offered. Take, for example, what the team called organic collision deformation. This was essentially a cover-all term for how Wander interacted with the colossi: how he was able to grab onto them, climb them in a dynamic way and also walk on them when the body part he's standing on is in a more or less horizontal position. When you think about it, that really is quite a remarkable element to the game, as each boss is supposed to be its own level in some ways. They are dynamic platforms that move and react, but that also needed to open up possibilities for Wander to

Key facts

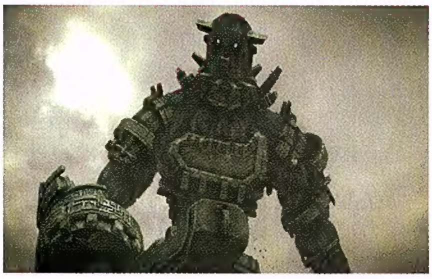
- Fumito Ueda was lead designer, artist and creative director on *Shadow Of The Colossus* and has admitted his desire to be involved in every stage of the game-making process is part of what makes them take so long.

- The original concept of the game included 48 colossi that you would have to defeat and included multiplayer, but this was all cut down due to technical constraints.

- An unused item in the code of the game called *The Eye of the Colossus* would have allowed you to view battles from the perspective of the colossi.

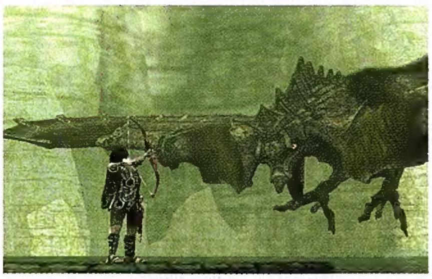
The fallen mighty

Some of our faves from the coterie of colossi.



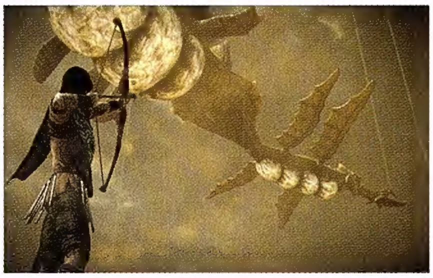
Gaius

It was only the third colossus we got to meet, but Gaius really sums up wonderfully all of the best elements of what conquering these giant creatures was about. The scale of it, embellished by standing on its own platform, running up its stone sword and climbing to its head, was a fantastic journey.



Avion

Our first flying adversary and quite a fun riddle to solve. Working out how best to get on Avion was the biggest challenge, but staying attached to one of the smallest colossi as it angled itself into turns and flew around its enclosure was a big part of the experience too.



Phalanx

The second flying colossi, and what an incredible thing it was to behold. The desert location is stunning and the structure of the fight even more enjoyable as you first bring it closer to the ground and then begin the process of boarding and traversing it to bring it down.

navigate them even more. We had really never seen anything quite like that before, so Team Ico had to come up with its own technical solutions for that to work, and we have to say it absolutely nailed it. The way you solve the puzzle of the colossi is a major part of the *Shadow Of The Colossus* experience, and the reality of these creatures is greatly enhanced by the physics of how you climb them.

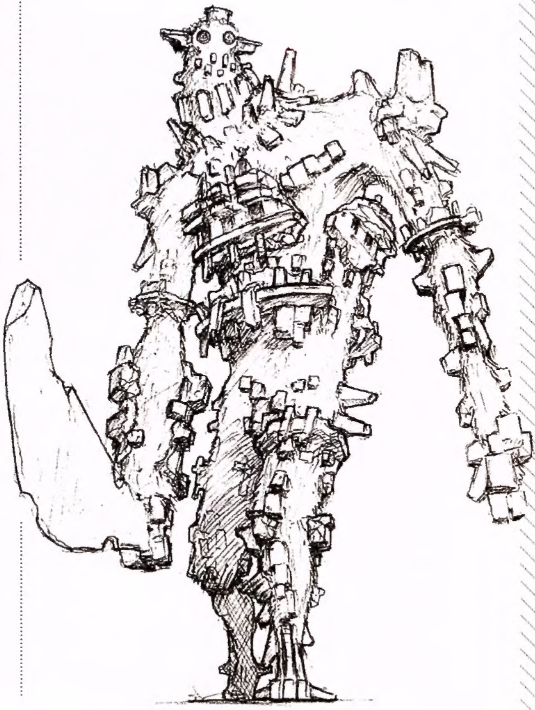
The second challenge was identified as player dynamics and reactions, which was how Wander, once on a colossus, would react to being on them and behave in unison with their movements or actions. These moving levels are obviously trying to shake him off, and they might be flying through the air and making sharp turns. To what degree should he be flung around by these movements? When does gravity work in his favour and when does it work against him? The introduction of the stamina bar and how it recharged when Wander is able to stand without aid added to the tension and risk/reward mechanics that these questions ultimately created. As he grabs fur he can be swung around, and he needs to naturally find his balance before progressing. It's the intuitiveness of what Team Ico created in these moments that helps to make the colossi more believable.

One of the more commonly complimented smaller elements of the game was the movement and animation of Agro, Wander's horse and faithful companion. Agro was unlike anything most of us had ever experienced from a companion animal in a videogame before, with a sense of her own agency. You don't control Agro; you can only encourage and guide her.

> "The technical challenges of Shadow Of The Colossus were numerous and really quite specific to the unique features the experience finally offered."

An extension of this was what Team Ico called motion blending, which covered the way both Agro and the colossi turned in a fluid and naturalistic way. This, combined with posture control, which was the fourth major pillar of *Shadow Of The Colossus'* biggest design challenges, meant that both Agro and the colossi stood on slopes, turned, ran and generally moved in a way that didn't break the illusion of the world.

All of these challenges were overcome to allow the majesty and spectacle of *Shadow Of The Colossus* to wow us unimpeded. Thanks to these technical achievements the incredible concept of having a game with only boss battles, where the giant adversaries were themselves the levels you had to overcome, in a desolate world that still managed to convey so much backstory and create so much intrigue, was accomplished. It should go without saying that open-world game design, emergent storytelling and boss-battle design have been massively influenced by what Team Ico and Fumito Ueda achieved with this stunning game. Even with all of the power and advancements of the last two generations, little can match *Shadow Of The Colossus* on its own terms, which was made all the more clear by the recent remake for PS4. For a game that tells you so little, it manages to convey so much and draw you into a deeply emotional and morally challenging experience. There is really nothing else quite like it in gaming, but we have no doubt that it will continue to inspire creators for years to come with how it executed its ideas so well. ■

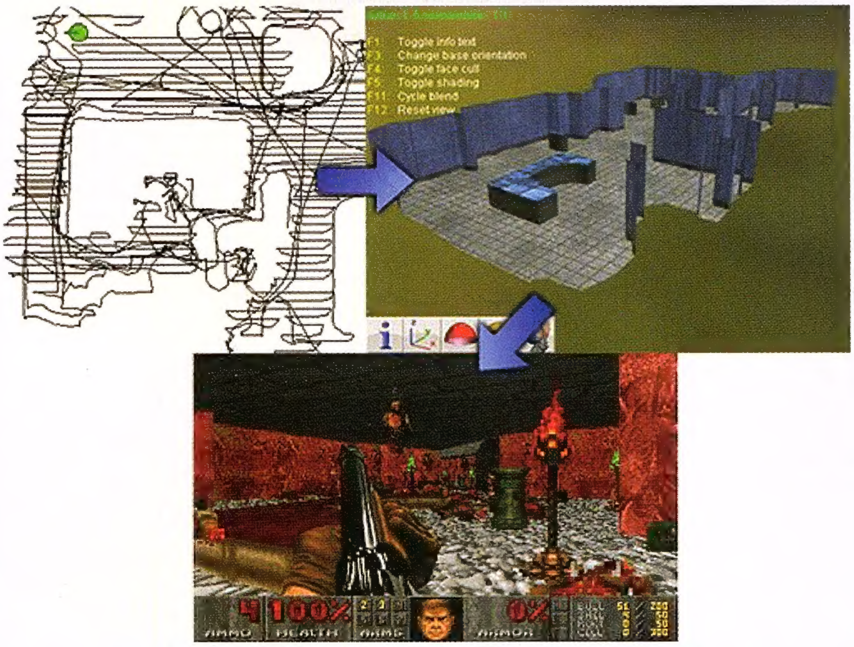


» JOEL BURGESS REPORTS ON THE UNUSUAL SIDE OF TECH NEWS.

China uses facial recognition in public toilets

Now all your movements will be tracked.

A colleague once said that society can be judged by the cleanliness of its public toilets – a sardonic riff on Russian literary icon Fodor Dostoyevsky's similar sentiment about the treatment of prisoners – but, China's new facial recognition scanners in public toilets show that this concept may be more prophetic than you think. The new face scanners in Zhangzhou's High-tech Zone are part of Xi Jinping's 'Toilet Revolution', which hopes to use personal identification to limit the toilet paper and the mess in China's public toilets. According to *Tech in Asia*, a successful ID check provides 90cm of toilet paper, but you'll have to stick to a strict time limit to avoid an alarm sounding.



Free software turns your Roomba map into a Doom level

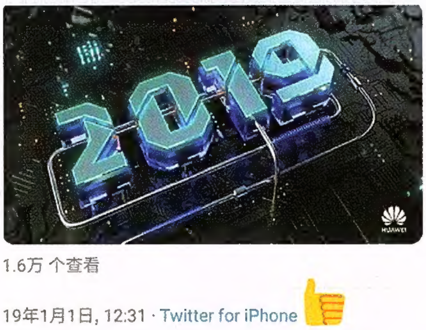
DOOMBA TAKES THE GLOOM OUT OF HOUSEWORK.

As the *'Can it run Doom'* Subreddit has proven, *Doom* can run on anything from calculators to ATM machines, but you can now also build new *Doom* levels using a freshly minted Roomba plugin. Doomba as this dust-busting level designer is called, uses the robot vacuum cleaner's collected schematics of your home to build novel maps for this 90s FPS. The map building software was released by game designer Rich Whitehouse right around Christmas and has been stress tested on a Roomba 980, but you'll need to download Whitehouse's Noesis software and follow a few (somewhat complicated) steps to convert your apartment into your very own playable hellhole.

Apple trolls CES with pointed billboard ads

APPLE REALLY WANTS YOU TO KNOW IT DOESN'T KISS AND TELL.

Apple has traditionally avoided Las Vegas's widely covered Consumer Electronics Show, but this year the company paid a hefty amount to make its presence felt. The Cuppertino company's main goal was to troll competitors with a skyrise billboard over one of the main convention halls that read "What happens on your iPhone, stays on your iPhone". In addition to the appropriated Vegas expression the ad's only other contents were a sketch of an iPhone XS and a link to Apple's privacy page. With the plethora of smart devices launched at the event there's no doubt the company was trying to cast shade – both figuratively and literally – on the rapidly evolving smart assistant space, by highlighting potential privacy concerns.



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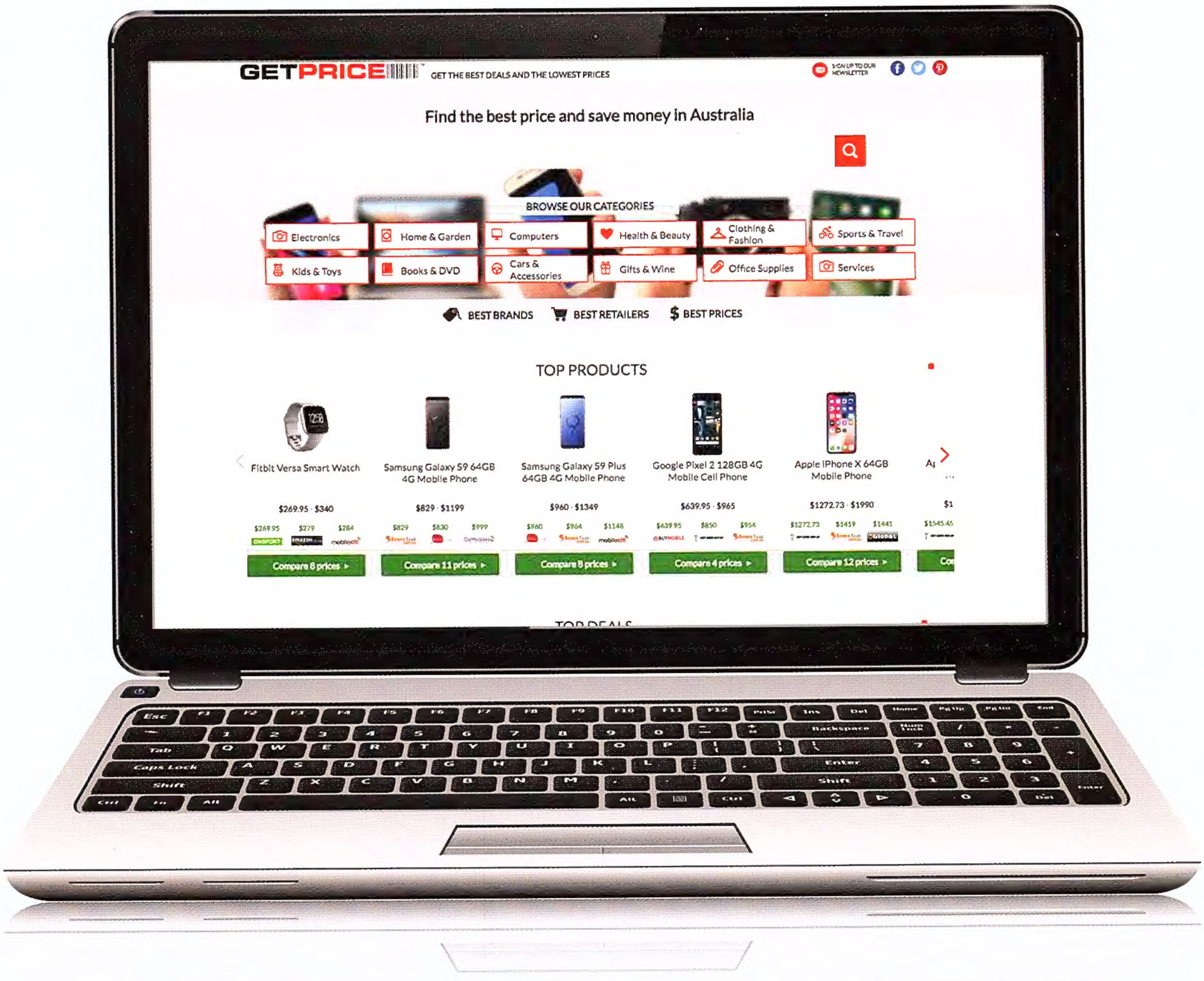
19年1月1日, 12:31 · Twitter for iPhone

Huawei demotes employees for Tweeting from iPhones

OFFICIAL ACCOUNTS NEW YEAR'S TWEETS CAUSED 'DAMAGE TO THE HUAWEI BRAND'.

Huawei has demoted two employees for a New Year's Day Tweet from an official Twitter account that was pushed live using an iPhone. It's not a great look for a big smartphone manufacturer to send out a Tweet with a note that its message was posted using a competitor's device, but there are a few mitigating circumstances that make the demotion and a 5,000 Yuan (approximately $1,000) monthly pay cut seem a little harsh. In addition to Twitter flip flopping on publishing the source of Tweets, it's difficult to access the banned social media site in China, requiring a VPN and a foreign sim card. ■



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